UNDERSEA WARFARE

U.S. SUBMARINES... BECAUSE STEALTH MATTERS

INDUSTRIAL STRENGTH

The Navy's Industry Partners Prepare to Build More Subs with 21st Century Efficiency

INSIDE

Winter 2011
Issue No. 43

On the Cover

A unit of the submarine *California* (SSN-781), arrives at Northrop Grumman Shipbuilding Newport News.

Photo by Ricky Thompson

UNDERSEA WARFARE

THE OFFICIAL MAGAZINE OF THE U.S. SUBMARINE FORCE

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Features

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"I look forward to serving together as we tackle the challenges ahead—challenges that will require all of us to know our mission orders, keep a keen and continuous periscope search, and act with boldness and initiative to seize opportunities as they arise—all part of our genetic make-up as submariners!"

Vice Adm. John Richardson, USN, Commander, Submarine Forces

As this is my first contribution to UNDERSEA WARFARE Magazine, let me begin by saying what an honor and privilege it is to be the Commander of our Submarine Forces. I look forward to serving together as we tackle the challenges ahead—challenges that will require all of us to know our mission orders, keep a keen and continuous periscope search, and act with boldness and initiative to seize opportunities as they arise—all part of our genetic make-up as submariners!

As I write this, we are in the midst of responding to two world crises: the disaster in Japan brought on by the earthquake and tsunami, and the situation in Libya, where Muammar Gaddafi and his government are firing on their own people, who are striving for freedom. As you would expect, the Submarine Force—our boats and our individual people—were among the first responders to these crises. Our thoughts and prayers are with the families of the victims and all the responders.

Before I get too far into this letter, I would like to wish VADM Jay Donnelly "fair winds and following seas" as he and Mimi move on to seize new challenges and opportunities beyond our Submarine Force! They were fantastic leaders and leave behind a Force capable of executing the most challenging missions in our nation's maritime history. Sir, we are all very grateful for a job well done!

I'd also like to recognize and congratulate several other key officers who are newly in leadership positions in the Submarine Force. A terrific submariner and my good friend, RADM Frank Caldwell, has taken command at COMSUBPAC, and I could not be more thrilled about the chance to serve with him. His predecessor, RADM Doug McAneny, developed and turned over a force in the Pacific that is tuned for high-tempo operations and is ready for combat if called. Many thanks, Sir!

Our other new operational commanders, RDML Bob Hennegan (COMSUBGRU NINE) and RDML Jamie Foggo (COMSUBGRU EIGHT), join the team that includes RADM Mike Connor at OPNAV N87, RDML Barry Bruner at COMSUBGRU TEN, RDML Mike McLaughlin at COMSUBGRU TWO, and RDML Robert Thomas at COMSUBGRU SEVEN. Also, since the last issue of UNDERSEA WARFARE, VADM Scott Van Buskirk is now serving as Commander, U.S. Seventh Fleet; VADM Joe Leidig has assumed duty as Deputy Commander, U.S. Africa Command; and VADM Cecil Haney has assumed duty as Deputy Commander, U.S. Strategic Command. It is a complete privilege to be serving with these leaders.

In 2011, as we execute the CNO's Maritime Strategy, we continue in an era characterized by increasing worldwide demands on the U.S. Navy in general, and the U.S. Submarine Force in particular. As the demands grow, we will be expected to meet the challenge—and we will. Our future will be characterized by providing expanded decision space to our leadership with a wider range of response options through our unique attributes of stealth, endurance and firepower. Our top responsibilities include:

- **Sustaining the nation's sea-based strategic deterrent.** The fleet of 14 *Ohio*-class SSBNs is approaching 26 years old and will remain a critical element of the nation's deterrent force for the foreseeable future. The program to replace the *Ohio*-class SSBN achieved Defense Acquisition Milestone A approval to commence construction later in this decade to ensure uninterrupted survivable deterrence.
- **Fulfilling our attack and guided-missile submarine commitments.** *Los Angeles*-class and, increasingly, *Virginia*-class submarines remain deployed around the world, advancing our national interests. SSGNs remain vital to the warfighter for their strike and special-forces payloads.
- **Aggressively and intelligently pursuing technology that will continue to advance unmanned underwater systems**, with increased endurance and capability.
- **Developing the Undersea Warfare Commander's Concept**, which will bring synergy and purpose to operations and warfighting in the undersea battlespace.

But the challenges do not stop there. Coincident with increasing responsibility, we are entering an era that will likely reduce available resources at all levels of government. With the 2010 budget deficit exceeding $1.3 trillion and the interest on the national debt consuming more of the budget, there will be tremendous pressure to execute more efficiently. We have little recent experience with managing requirements in an era of declining resources—the defense budget has steadily grown for more than a decade. We must reconcile these diverging trends of increasing demand and declining resources through a balanced approach that strives to succeed at doing what is essential, understanding where we need to make changes, and eliminating what we can do without.

To answer this challenge, our leadership team is in the final stages of designing a Submarine Force Campaign to guide our thoughts, shape our mindset, and direct our decisions and actions. As with all campaigns, a key ingredient to success will be communication, alignment and execution. I look forward to your contributions as we embark down this path together.

"I have had the privilege of watching submariners at work over the past two years during my tour in Yokosuka, Japan. The accomplishments of the deployed Submarine Force are fresh in my mind, and I look forward to continuing the faithful effort of VADM Cecil Haney as the director of submarine warfare requirements."

Rear Adm. Michael Connor, USN, Director, Submarine Warfare

I am greatly honored to address you for the first time in UNDERSEA WARFARE. I have had the privilege of watching submariners at work over the past two years during my tour in Yokosuka, Japan. The accomplishments of the deployed Submarine Force are fresh in my mind, and I look forward to continuing the faithful effort of VADM Cecil Haney as the director of submarine warfare requirements.

As the resource sponsor for the Submarine Force, my priorities are:

1. **Launch the *Ohio* Replacement Program.** Nuclear deterrence remains one of our nation's most vital and essential missions. This program is a commitment of the nation's resources that we make only every 45 years. This deterrence mission, which we once accomplished with the "41 for Freedom" submarines and currently fulfill with 14 *Ohio*-class SSBNs, will in the future only require 12 next-generation SSBNs (*Ohio* Replacement). Of significant note, the *Ohio* Replacement Program recently received Milestone A authority—the formal step that allows the program to enter the Technology Development Phase. We are now working to mature the necessary technologies to build 12 SSBNs, each carrying 16 Trident II (D5) Life Extended Missiles, with the requisite stealth to maintain the nation's most survivable nuclear deterrent.
2. **Maintain the SSN Force Structure.** U.S. attack submarines (SSNs) provide the nation stealth and firepower that can operate anywhere in the world at any time. As other countries invest in technologies to restrict access and the freedom to operate in international waters and airspace, SSNs continue to provide persistent, non-provocative presence. Should tensions escalate, SSNs operating far forward will be a key enabler, creating gaps in an adversary's area-denial web for surface and air forces.
3. **Refocus the Submarine Payload Strategy.** Submarines require the right weapons and sensors, with the right capabilities, in the right quantities for a rapidly changing world. Our inventory is currently limited to three weapons, and we are only beginning to explore unmanned systems. In the dynamic world we will live in, we will provide operational commanders with payloads that support missions across the spectrum of operations. We will work closely with the fleet to ensure we reach the right answer.
4. **Undersea Warfare: Submariners Are the Experts.** Various organizations are developing new undersea technologies that will enhance the Navy's future capabilities. We need to ensure that these systems are built with the right command and control system to complement, and not compete with, what our submarines are already doing. Undersea commanders must have the ability to control and redirect these technologies in a timely manner so that all assets are working towards a common goal.

Congratulations to VADM Jay Donnelly for his outstanding leadership as our Submarine Force commander. He has left behind an unmatched legacy of service to the submarine community and our nation. We also welcome VADM John Richardson as our new force commander and look forward to taking on exciting challenges and opportunities under his leadership.

UNDERSEA WARFARE
The Official Magazine of the U.S. Submarine Force

Charter

UNDERSEA WARFARE is the professional magazine of the undersea warfare community. Its purpose is to educate its readers on undersea warfare missions and programs, with a particular focus on U.S. submarines. This journal will also draw upon the Submarine Force's rich historical legacy to instill a sense of pride and professionalism among community members and to enhance reader awareness of the increasing relevance of undersea warfare for our nation's defense.

The opinions and assertions herein are the personal views of the authors and do not necessarily reflect the official views of the U.S. Government, the Department of Defense, or the Department of the Navy.

Contributions and Feedback Welcome

Send articles, photographs (min. 300 dpi electronic), and feedback to:

Military Editor Undersea Warfare CNO N87
2000 Navy Pentagon, Washington, DC 20350-2000
E-Mail: underseawarfare@navy.mil
Phone: (703) 614-9372 **Fax:** (703) 695-9247

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CHINFO Merit Award Winner

Silver Inkwell Award Winner

In keeping with UNDERSEA WARFARE Magazine's charter as the Official Magazine of the U.S. Submarine Force, we welcome letters to the editor, questions relating to articles that have appeared in previous issues, and insights and "lessons learned" from the fleet.

UNDERSEA WARFARE Magazine reserves the right to edit submissions for length, clarity, and accuracy. All submissions become the property of UNDERSEA WARFARE Magazine and may be published in all media. Please include pertinent contact information with submissions.

Send submissions to:

Military Editor
Undersea Warfare CNO N87
2000 Navy Pentagon
Washington, DC 20350-2000
or **underseawarfare@navy.mil**

dear **EDITOR,**

As a reader of UNDERSEA WARFARE Magazine for almost 12 years, I have enjoyed the remarkable articles, both contemporary and historical, concerning the United States Submarine Force.

As a keen student of naval history, I would like to suggest, if possible, including a regular book review section in the Magazine. If memory serves rightly, I have only seen two book reviews that were published, specifically, the review of Douglas Waller's *The Big Red* by Lt. Cmdr. Jim Doody, in the winter 2001 issue, and the condensed version of the book *Full Fathom Five*, by Mary Lee Coe Fowler, in the spring 2010 edition.

I believe in the vital importance of book reviews for their impact on our professional development and as an inspiration for preserving naval history, with emphasis on submarine warfare and submarine heroes.

I hope the possibility of a regular book review section could be looked into, and I would be delighted to submit reviews for a future issue of the Magazine.

Cmdr. Mark R. Condeno
Liaison Officer, Foreign Armed Forces Attaché Corps
Philippine Coast Guard Auxiliary

Cmdr. Condeno,

Many thanks for your suggestion and your interest in UNDERSEA WARFARE Magazine. We certainly agree about the importance of professional reading, particularly naval history, for developing well-rounded naval officers and senior enlisted personnel. We have considered publishing book reviews in the past but have not done so for several reasons, among them limited space, the difficulty of selecting only four books each year among hundreds of worthy candidates, and concern about seeming to endorse any commercial product. Our recent article based on the book Full Fathom Five *was, as you noted, not actually a review, but rather a set of highly condensed excerpts.*

We are always happy to get suggestions from our readers about how to improve the Magazine. We brought your suggestion to the attention the Submarine Warfare Division in the Office of the Chief of Naval Operations (OPNAV N87), which governs UNDERSEA WARFARE Magazine's content. However, for the reasons stated above, N87 deemed it inadvisable for the Magazine to begin publishing book reviews at this time.

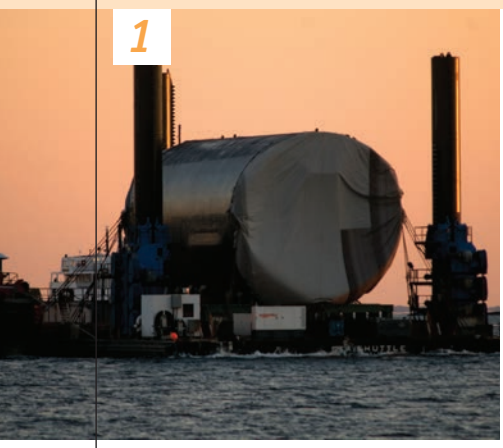
sailors**FIRST**

Photo by Petty Officer 1st Class Peter Blair

Petty Officer 2nd Class Leonard Wagner, USS *Miami* (SSN-755) Junior Sailor of the Year, writes a "Thank You" note to the students of Catherine Kolnaski Magnet School in Groton, Conn., who created nearly 300 Valentine's Day cards for submarine Sailors along the waterfront at Naval Submarine Base New London.

yard work

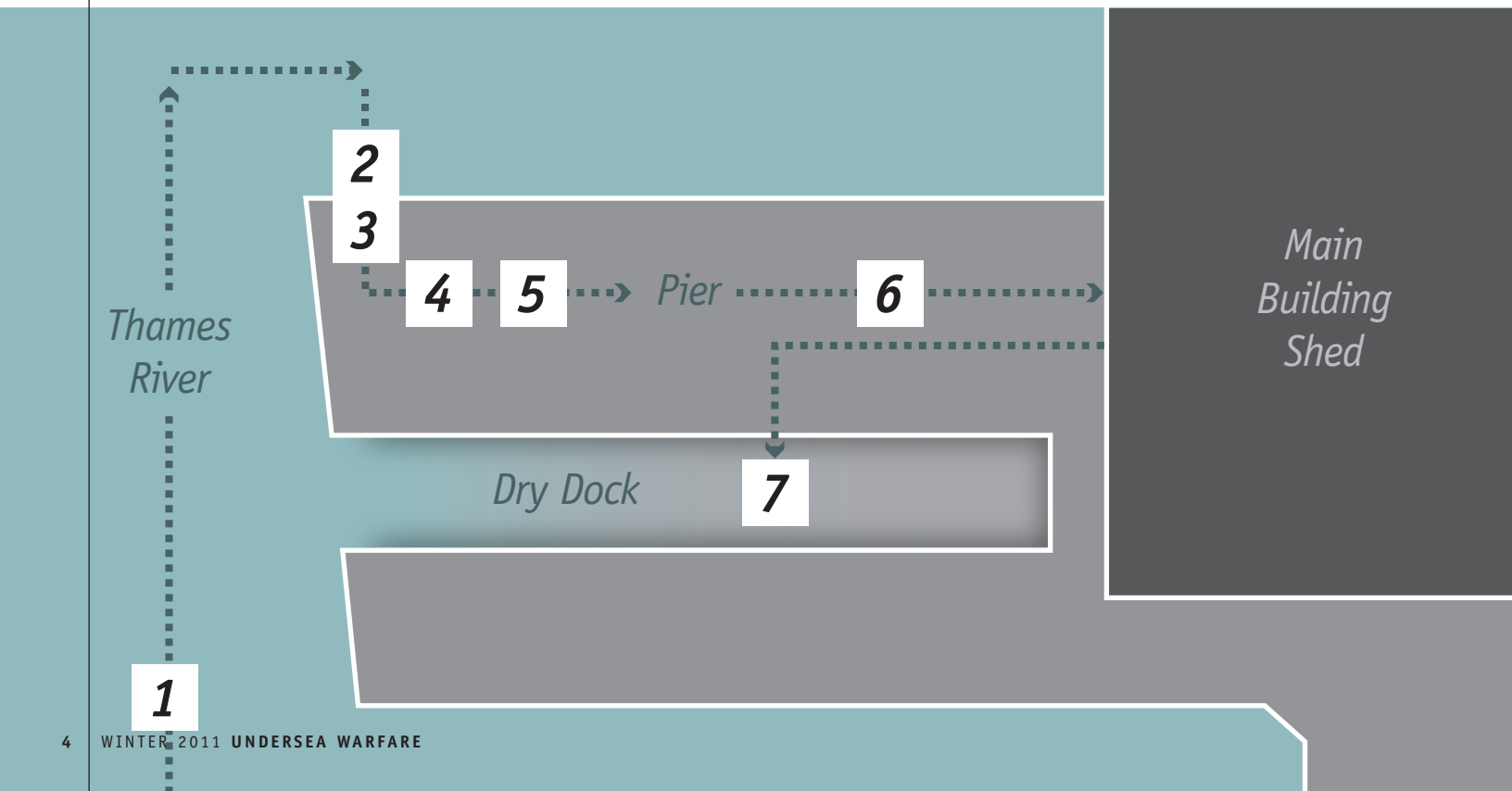
Moving Giant Hull Sections



The Sea Shuttle Barge Arriving with a Hull Section off Groton, Conn. This highly specialized barge had to be strengthened to handle the larger modules now being shipped under the four-module build plan. The vertical steel columns projecting up from the deck are actually legs. At the shipyard, they will be lowered to the bottom to keep the barge firmly in position as the module is transported ashore.

The Sea Shuttle Barge Docked at the Electric Boat Shipyard in Groton. The barge has docked beside the upriver end of the shipyard pier, and the three legs have been lowered to the bottom in preparation for transferring the hull section ashore. Beams and bracing support the hull section during transit. A bit of the bracing is visible to the right of the blue structure surrounding the nearest leg.

The Module Moves Ashore. In this long-distance shot taken from the roof of the Main Building Shed, the land transporter has slid beneath the beams supporting the module, lifted the entire load, and begun to carry it onto the pier. Before the introduction of new modular land transporters like this one, previous transporters had to remain beneath the module on the barge during the seaborne transit. This added to the total weight on the barge and thus reduced the maximum payload the barge could carry.



Of the many technical breakthroughs made so far in building the *Virginia* (SSN-774) class, perhaps the most important — and certainly the most visually arresting — is reducing from ten to four the number of hull sections that reach the final assembly yards.

Experience has demonstrated that it is more efficient — and therefore less costly — to deliver fewer hull sections to the yards in a more advanced state of completion. Consequently, as part of the ongoing effort to reduce cost so the Navy can acquire more submarines, General Dynamics Electric Boat and Northrop Grumman Shipbuilding are routinely handling larger and heavier hull sections than ever before.

The following photos provide a glimpse into how that work gets done. (To find out more about the origin and benefits of the four-module build plan, see the following article.)

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The Land Transporter Begins to Turn. This is a good view of how the transporter carries the hull section, still supported by the beams and bracing that held it in place on the barge. The modular nature of the wheeled sections that support the load is apparent. Adding modules enables the transporter to carry hull sections larger than the one shown here. Note that the wheels of the forward modules are beginning to make the 45-degree turn toward the landward end of the pier.

5

Turn Completed. After making the turn, the transporter shifts to the left before proceeding up the pier toward the Main Building Shed. The wheels align to make the shift without changing the orientation of the transporter. The power modules project from the front end of the transporter assembly. The end plate on the module makes it unnecessary to cover that end.

6

Moving Along the Pier. The transporter carries the hull section toward the building shed. To the left, the previous submarine assembled at the Groton shipyard has been lowered into the dry dock, where it is receiving the final touches prior to float-off.

All photos courtesy of General Dynamics Electric Boat

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The End Product Takes to the Water. The final assembly process, which begins with the arrival of the four large modules at the shipyard, culminates with the flooding of the dry dock so that a completed submarine can float off. In this case, the submarine is USS *Missouri* (SSN-780).

by John D. Holmander and Thomas Plante

The Four-Module Build Plan

The Second Decade of *Virginia*-Class Construction Gets Better

The delivery of USS *New Hampshire* (SSN-778) in August 2008 marked a new standard of efficient modular construction in the building of *Virginia* (SSN-774)-class submarines. This ship, the fifth *Virginia* and the first to be built under the Block II contract, was delivered eight months early and over $90 million under the target cost. Significant achievements in building *New Hampshire* included:

- Reducing the construction schedule by 20 percent — 15 months less than the previous two ships delivered by Electric Boat.
- Reducing construction labor by 25 percent, or 3.7 million labor hours, compared to the lead ship of the class.
- Reducing the cost of the delivered ship by $500 million compared to the lead ship.
- Delivering the ship in a more advanced state of completion than any previous unit of the class, including having the hull coating completely installed at delivery, a first for any of the *Virginias*.
- Enabling the Navy to deploy the ship overseas prior to its post-shakedown availability (PSA) maintenance period.

Going from Ten Modules to Four

During the six years it took to build *New Hampshire*, the U.S. Navy, General Dynamics Electric Boat, Northrop Grumman Shipbuilding Newport News, and the many vendors who support the two shipbuilders all focused on continuous improvement on a daily basis. This resulted in hundreds of significant process and facility improvements. Arguably the most noteworthy of these improvements was the four-module build plan. This innovative build plan called for the module manufacturing facilities of both shipbuilders to deliver four "super modules" to the final assembly yards rather than the 10 smaller modules delivered for the final assembly of previous *Virginia*-class submarines.

The "1-3-8" Rule of Thumb

To appreciate the importance of the four-module build plan, it is necessary to understand the advantages of accomplishing as much as possible early in the construction process. A useful shipbuilder's rule of thumb called the "1-3-8 rule" compares the amount of labor hours required to accomplish the same work in succeeding states of submarine construction.

The earliest part of the construction process takes place on the shop floor. This is generally the most efficient work environment because plans, tools and jigs to facilitate assembly are readily available, and utilities are easy to access. It is also the easiest place for supervisors to provide

Photo courtesy of General Dynamics Electric Boat

guidance when needed and to observe and correct deficiencies early enough to avoid rework. Finally, the shop is a controlled environment, so work there can continue in all weather.

As work packages are assembled into larger units called modules, the work moves to outfitting buildings that are specially designed to handle the heavier units and align the various modules for insertion into hull sections. (Note that the "modules" discussed here are not the same as the large hull-section modules discussed earlier; these modules are packages of equipment that will eventually be inserted into the large hull sections.)

An outfitting building is a less efficient workspace than the shop floor because adjacent systems increase congestion, and equipment already installed in modules limits access. A task that takes one hour on the shop floor requires roughly three hours in an outfitting building.

The least efficient work environment is inside a hull. Once hull sections are assembled into a complete hull, personnel working within are much more remote from their bench tools and other resources, and access, congestion and safety become much greater concerns. Thus, a job that could be completed in one hour on the shop floor or three hours in a modular outfitting building can take up to eight hours inside a hull.

Following the 1-3-8 rule of thumb, the best strategy is to maximize work in the shop environment and minimize work within the hull. Among other things, this means increasing the size, weight, and state of completion of modules prior to inserting them into hull sections. Some "rafts" (the term for large assembly packages inserted whole into hull sections) for the *Virginia* class weigh more than a million pounds. For a comparable portion of the ship, one *Virginia* raft load typically replaces 12 raft loads for the previous *Seawolf* (SSN-21) class and as many as 18 for the earlier *Los Angeles* (SSN-688) class.

Applying the 1-3-8 Rule to the *Virginia* class

From the start, the *Virginia*-class design was tailored to optimize the construction process, facilitate the integration of supplier equipment, and incorporate Navy operational and maintenance experience. The design exploited modularity to maximize the construction that takes place in an open shop environment and minimize what has to be done within the confines of a hull.

The four-module build plan takes that successful approach to the next level. By moving critical-path work earlier in the schedule, it shortens construction cycle times, improves learning, and facilitates timely identification and reduction of risk. Not surprisingly, the first application of this plan, in *New Hampshire*, reduced costs and accelerated the schedule compared to previous ships. Additional cost and schedule improvements are already being realized in follow-on ships.

In their ongoing search for process improvements that will lower construction costs, General Dynamics and Newport News continually evaluate performance in each phase of *Virginia*-class construction to discover and implement process and productivity improvements that will reduce labor, service and support costs on subsequent ships.

In parallel, the shipbuilders are pursuing an ambitious effort to optimize the entire construction process and significantly shorten construction time. By further increasing the work completed prior to finally assembly, they plan not only to reduce the cost of that specific work, but also to enable their final delivery yards to focus more exclusively on their core competencies — final construction, test, sea trials, and delivery.

Historic Progress in Modular Construction

The first submarine of the *Los Angeles* class was authorized in 1970. It was built using the traditional technique of joining empty hull sections and then loading individual systems and pieces of equipment through patches cut in the top of the hull. As *Los Angeles*–class construction progressed to later ships, preassembled packages of systems and equipment were top-loaded through the hull patches. However, construction remained inefficient because most work was still performed within the constrained environment of the hull.

Modern modular submarine construction techniques were pioneered in the building of the *Ohio* (SSBN-726) class, which got under way in the mid-1970s. The large-diameter *Ohio* pressure hull and a design that explicitly increased access made it easier to develop rafts that could be inserted in larger pieces, as did the new land-level assembly area that replaced the old inclined building ways. New techniques were only applied to a limited extent in early ships of the class, but later ships transitioned to more fully outfitted hull sections as shipbuilding facilities were upgraded to handle larger modules and heavier hull sections.

As the *Ohio* class progressed, modules

(Opposite) An open shop floor is by far the most efficient work environment. Here, EB employee Shawn Faria checks welds on the first *Virginia* payload tube.

(Left) Assembled in an efficient open work environment, a "raft" of equipment for the auxiliary machinery room is now ready to slide into the tight space of a hull section at EB's Quonset Point Facility.

grew increasingly complex, and their weight increased from 600 tons to more than 1,400 tons. The *Seawolf* class, which began in 1989, included major advances in modular construction even between ships. For example, in USS *Seawolf*, section four was 28 percent modular and weighed 769 tons, whereas in USS *Connecticut* (SSN-22), ordered just two years later, section four was 78 percent modular and weighed 1,150 tons. Hull sections for the current *Virginia* class are more than 95 percent modular, with modules approaching 2,000 tons.

Evolution of the *Virginia*-Class Build Plan

The *Virginia*-Class Program began in the early 1990s with the mandate to develop an affordable submarine that would meet the operational needs of the Navy in the 21st century. Electric Boat used an integrated product and process development (IPPD) approach to ensure that the design and the associated production and material-ordering plans would be completed in time to support an efficient modular build plan.

Experts from the Navy, the design yard, the shipyard, and planning and material organizations formed the initial design-build teams and produced the first *Virginia* manufacturing and assembly plan in September 1992. The plan took advantage of advances in submarine modular construction at the time and incorporated technology that supported large, highly outfitted modules. Major modules, formed around 10 major areas of the ship, included not only deck packages but also the hull cylinders and non-pressure hull sections.

The goals of the initial build plan were on-time delivery to an 84-month construction schedule, increasing modularization to greater than 95 percent, and reducing change orders during construction. Tools and organizations were established to fit the process, and even the February 1997 introduction of a second shipbuilder through a co-production agreement went smoothly.

Electric Boat and Newport News began modular manufacturing in earnest in late 1997. The co-production agreement divided the manufacturing of modules between the two firms, with deliveries of completed submarines alternating between them. Whichever yard was delivering the submarine had to perform four end loads, complete eight critical installs, and complete five hull butts before final outfitting, assembly and test.

Photo courtesy of General Dynamics Electric Boat

The small entryways accessed by catwalks atop *Missouri*'s completed pressure hull indicate how much more difficult—and costly—it can be to perform work in a closed hull.

Electric Boat delivered the lead ship, *Virginia*, in October 2004, and Newport News followed with the delivery of USS *Texas* (SSN-775) in June 2006. Even before the delivery of these two ships, plans were being formulated to take the *Virginia*-class build plan to the next generation of modular construction.

The Four-Module Build Plan

The four-module build plan was driven in part by the accomplishments of another submarine program at Electric Boat. USS *Jimmy Carter* (SSN-23), also delivered in late 2004, had a unique hull section inserted late in the construction process to support special mission requirements. The new section was 100 feet long and weighed 2,500 tons when shipped from Electric Boat's manufacturing facility at Quonset Point, R.I., in November 2002.

The original plan had been for Quonset Point to ship two smaller, less outfitted modules — one weighing 1,443 tons and the other 981 tons — to EB's final delivery yard in Groton, Conn. However, that would have required 70,000 hours of additional unplanned work at Groton. Analysis at the time showed that joining the two modules at Quonset Point and outfitting the resulting larger hull section more completely before moving it to Groton would save $2 million.

The problem was that this very large hull section exceeded the capacity of the existing submarine module transportation system, which consisted of the sea shuttle barge and transporters for the land-borne phase of the move. However, EB's analysis had also shown that a new method combining existing and specially leased assets could safely transport a hull section of 2,500 to 3,000 tons. Using this method, EB completed the movement of the larger hull section for *Jimmy Carter* on Nov. 21, 2002.

Fresh from this success, experts from Electric Boat worked with Newport News to achieve similar improvements in the *Virginia* class, starting as early as the last two ships of Block I. The resulting four-module build plan took advantage of the fact that module weights were no longer limited to 1,580 tons by the capacity of the former transportation system, which had employed two 96-wheel transporters each capable of moving 790 tons. The fact that the transporters no longer had to be shipped with the modules further increased the maximum feasible module weight.

By drastically increasing the transportable module weight, this second generation of transportation technology opened up virtually unlimited possibilities for construction

planners. For the first time, the build plan could be based on an approach that made the most sense from an efficiency standpoint — i.e., performing module manufacturing at module outfitting facilities and doing only final assembly at the delivery shipyards. Consequently, improvements to the module transportation system are expected to save more than 1.2 million construction hours on the remainder of the 30 ships currently planned for the *Virginia* class.

In addition to seven major deck packages, each *Virginia*-class submarine has 10 major hull sections, all of which are outfitted with systems and components. The four-module build plan calls for assembling these deck packages and hull sections into four larger structures — section 1-2A, section 2B-5, section 6-7 and section 8-9. This reduces the number of module end loads performed by the final assembly yard from four to one, reduces critical installs from eight to one, and reduces the number of hull butt welds from five to three.

With the new build plan in place, overall construction time could be reduced to help meet the cost-reduction goals established for Block III *Virginia*s as well as speeding their delivery. The construction strategy therefore focused on reducing the construction span from 100 months to 60 months (including all post-delivery work). However, span reduction presented a new set of challenges to the teams at Electric Boat and Newport News and to the Navy pre-commissioning crews.

First, capital was needed to improve facility and transportation infrastructure. This was made available through an innovative Navy capital investment strategy that the *Virginia*-class Block II contract called the capital expenditure incentive, or CAPEX. This incentive, which has become a model for other procurement programs, provides funding for facilities and tooling to support cost-reduction efforts.

Under CAPEX, the two shipbuilders developed and implemented ten projects that required the investment of just $60 million to achieve projected savings totaling $400 million. The ten projects included such improvements as the transportation system upgrades, a coatings facility, a light metal fabrication facility, a modular outfitting facility, pre-launch and final assembly facility upgrades, and special-purpose machining centers and tools.

Next, planners needed to revise the material ordering plan to support a build plan that would increase the amount of module fabrication accomplished in the first year from 2 to 3 percent historically to more than 10 percent. Accelerating this work in the first year has the affect of pulling the whole construction schedule to the left.

Starting in Block II, Electric Boat and Newport News applied new technology, methods and techniques to increase the amount of outfitting that could be accomplished in the module manufacturing phase as well as to streamline final outfit, assembly and test — the final phase of a submarine's construction. The two shipbuilders achieved key advances in accuracy control, vertical outfitting, weight handling, and integrated manufacturing technology and systems.

Applying hull coatings during construction instead of during post-shakedown availability (PSA) helps reduce time spent in PSA by 60 percent. Installing electronics later in the construction cycle obviates the need for a post-delivery electronics modernization period. Redesigning sonar hull arrays to move them off of hull butts facilitates the modular build and reduces assembly time. Even staging has been improved, with prefabricated modular staging that can be placed and removed more rapidly with no compromise to safety.

Final outfit, assembly and test, the last phase of construction, begins when the first module arrives from the manufacturing facilities and continues through the arrival of all the remaining major modules and delivery of the ship. Key activities include aligning the major modules for hull erection, performing critical installs and exterior outfitting, closing the pressure hull, performing all system tie-ins and completing the test and acceptance process.

For the lead ship, *Virginia*, this process took almost 24 months. The next ship delivered by Electric Boat, USS *Hawaii* (SSN-776), benefited from partial implementation of the four-module build plan, with more complete sections of the ship being delivered to the final assembly yard in Groton. One example was Section 2B-5, which was delivered to Groton with a greater amount of outfitting completed and the habitability module already installed.

Moving critical path work such as end loads, hull butts and critical installs back to the module manufacturing phase means less time spent in final assembly, outfit and test. For *Hawaii* this last phase took just 16 months — eight months, or 33 percent, less than the lead ship.

Electric Boat is in the process of reducing the final assembly span to 12 months or less to help accelerate overall construction time for the remainder of the class. *New Hampshire* took approximately 13 months from pressure hull closure to delivery, with the last six months being in the water. USS *Missouri* (SSN-780) benefitted from an $18 million capital improvement to improve efficiency in the final assembly phase of construction. The investment improved worker access to the ship and access to utilities, thereby reducing recurring service and support costs and improving working conditions and employee morale. By making final assembly and test more efficient and cost-effective, it will save more than a million labor hours.

More Advances in Sight

The four-module build plan for the *Virginia* class has greatly advanced the state of the art in modular shipbuilding, and further advances are in the offing. Electric Boat's experience with *Jimmy Carter* demonstrated that even larger modules can be safely transported. Further increases in size and weight hold the promise of additional reductions in labor hours, and thus in the final cost not only of the remaining *Virginia*s, but also of future classes.

Electric Boat continues to advance modular submarine construction. Currently in concept development is the assembly of fully outfitted and tested modules that follow the natural functions of the ship, such as propulsion or the forward compartment. Modules of this sort could exceed 4,000 tons—twice the weight of the *Jimmy Carter* special section, and almost the entire weight of USS *Nautilus* (SSN-571), the pioneering nuclear submarine that started it all.

John D. Holmander is Electric Boat's vice president for the *Virginia*-Class Program. Thomas Plante is the EB program manager for the *Virginia* class.

by Jim Roberts

DOUBLE VISION

Planning to Increase *Virginia*-Class Production

WHEN Northrop Grumman Shipbuilding turned over USS *New Mexico* (SSN-779) to the U.S. Navy in December 2009, it became the third submarine of the *Virginia* class to be delivered by the company's Newport News shipyard in three years, and the sixth overall for the *Virginia* Class Program. Current plans call for building a total of 30 *Virginia*-class submarines.

Northrop Grumman Shipbuilding is teamed with General Dynamics Electric Boat, which is the prime contractor for the *Virginia* class, to build the first 18 boats. These state-of-the-art warships require millions of parts, provided by more than 4,000 suppliers in 47 states and the District of Columbia.

Northrop Grumman Shipbuilding builds the stern of each boat, habitability and machinery spaces, the torpedo room, the sail, and the bow. General Dynamics Electric Boat builds the engine room and the control room. Northrop Grumman Shipbuilding and Electric Boat each perform work on the reactor plant as well as alternating lead on the final assembly, test, outfit and delivery.

Northrop Grumman's focus at present is to continue improving performance on the remaining ships it is building under the "Block II" contract, including *California* (SSN-781) and *Minnesota* (SSN-783), with an eye toward the faster submarine delivery schedule outlined in the new Block III contract. This latest contract adds eight ships to the company's backlog and ramps up overall production to two deliveries per year beginning in 2017.

Becky Stewart, the company's vice president of submarine programs, attributes the ever-improving performance to the challenge the Chief of Navy Operations made several years ago to shipbuilders and Navy program managers to identify reductions in cost and schedule that would reduce the cost per submarine to $2 billion. This reduction would enable the Navy to increase its orders from one submarine per year to two.

From the deckplate to program management, ideas for cost reduction were generated to simplify the design for producibility, to adjust schedules and accelerate production, to reduce material acquisition cost, to find labor efficiencies and to incorporate lessons learned from ship to ship and between the shipbuilders. New cost-reduction and schedule-acceleration approaches made it possible to deliver *New Mexico* in 70 months — four months before the contract delivery date — and with one million fewer man-hours than Northrop Grumman's previously delivered ship, USS *North Carolina* (SSN-777).

"It has been a full-on industrial effort to get to a cost of $2 billion per sub and to reduce the build schedule toward 60 months," said Stewart. "Hats off to all of our industrial partners, our suppliers and the Navy as we begin to approach that goal."

Tom Ward, the manager who leads Northrop Grumman's program office for the *Virginia* class, and Bob Meyer, the company's construction director for the program, are very clear about their goal. Doubling production cannot mean doubling the workforce, because that would merely drive up the cost again. Although there will be some new hiring, the main thrust must be to employ the existing workforce more productively.

One example is changing the number of production employees in the first, second and third shifts in order to distribute the workforce more evenly. In 2009, the program reduced the first shift from 79 percent of total manning to 66 percent, while increasing manning in the second shift. The eventual goal is to have 55 percent of the workforce on first shift, 35 percent on second and 10 percent on third.

"Two per year is not necessarily the pure instigator for greater utilization of second and third shift," Meyer said. "I think we recognized that was something we had to do — a self-proclaimed mandate. We've got to use the clock better. We're committing to some significant reductions in total span times in building submarines, and you can't do that purely just by working harder. We've got to better coordinate the work itself."

Ward added: "We're not doing it just because it's good to beat a contract delivery date. We're doing it because that's how we continue improving the performance of the program and maintaining the momentum that we've generated to date. That leads to success on Block III and sets us up for Block IV and beyond."

"Two per year" will also require investments in the facilities through capital upgrades, including a new heavy plate press and additional hardware for the machine shops and dimensional control department. There are also plans to build a work cell to support the *Virginia* Class Program in the former receiving warehouse, which was vacated when the consolidated warehouse opened.

Perhaps the biggest change will be the construction of a 70,000-square-foot supplemental module outfitting facility (SMOF). The SMOF, which will be located at the northeast corner of the existing module outfitting facility in the Newport News shipyard, is expected to open in October 2012.

Ward said the capital investments come with a caveat: improved performance. "We have a commitment [to Northrop Grumman's corporate leadership] to satisfy a business case for the capital plan that requires us to perform on budget for Block III," he said. "So in return for corporate allowing us to build the facilities, we have promised that we would be able to perform on budget."

It's a tall order. The *Virginia* class is often referred to as the Navy's best shipbuilding program, but there are constant demands to improve, and the program needs to double production without losing any of its current efficiencies.

"No matter how well we did the last time, there is an expectation that we will do it even better the next time," Ward said. "This includes the transition to two per year and the addition of new people to [*Virginia*-class construction] that will support the increased production rate. Our expectation is the new people will be smoothly integrated and will

Northrop Grumman Shipbuilding-Newport News welder Melvin Holloman works on the sail unit for the submarine *Mississippi* (SSN-782) in the ring module shop.

work as efficiently as the people that are already here."

Meyer added: "There is incredible pressure to not backslide, to not rest on your laurels, to strive to improve on everything we do. It is a real challenge. It's one that requires renewed effort by everyone internal to the program. It requires a renewed energy by everybody involved to make sure we're continually advancing. There is no opportunity to sit back and say, 'Well, we've got this licked.'"

Of course, Northrop Grumman Shipbuilding is not alone in its efforts. Electric Boat alternates delivery of submarines with Northrop Grumman and serves as a "competitive partner" in the "two per year" planning.

"We're very fortunate that we have a strong shipbuilder as a teammate who is constantly challenging us, and we challenge them," Meyer said. "They come up with ways to further improve the program, and we do the same. The relationship between us constantly drives the whole team for success."

What can shipbuilders do to support "two per year" planning and overall performance on the *Virginia* Class Program? In addition to staying aware of the program's strategies and commitments and sharing ideas for improvement, "there needs to be a continued focus on quality performance — first-time quality in everything we do," Bob Meyer said. "We've got to continue to make sure we've got a safe environment ... and continue to find ways to further reduce costs and schedule span times."

Jim Roberts is manager of employee communications at Northrop Grumman Shipbuilding-Newport News. Northrop Grumman employees Margaret Mitchell-Jones and Michael Duhe also contributed to this article.

What's It Like to Work the Late Shift?

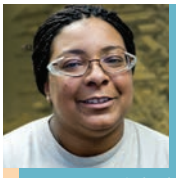
Part of Northrop Grumman's preparation for delivering two *Virginia*-class submarines per year is increasing the percentage of employees working on second and third shifts.

"I think people see some real opportunities there," said Bob Meyer, Northrop Grumman's construction director for the *Virginia* class. "Once people experience it, they kind of find a niche there. We're working hard to make sure they've got the support networks and infrastructure in place so they can be truly effective there and really heighten the contribution that we get from those folks."

What do the shipbuilders who work the night shift think? This is what three yard employees working nights to build the *Virginia* class had to say:

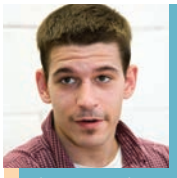
James McClain, Surface Preparation and Treatment Department:

"I like second shift because it gives me more time with my family. I feel I can be recognized for who I am and for my individual achievements. I definitely enjoy second shift. ... My days are open, not only for my family, but to take care of personal business. Everything is open on first shift. ... I'm thankful that I had an opportunity to come to second shift. It's really made a difference for the positive, and I enjoy it."



Tonaya Gary, Surface Preparation and Treatment Department:

"Third shift, you can get your job done. ... I feel like I'm learning more and the work is more efficient. On third shift, you can go ahead and knock your work out and be working on your back-up jobs. ... As for my personal life, I don't have to worry about a baby sitter. I can go on school trips with my son. If he gets sick, I can be the one to take care of him. It's easier on me."



Tom Richardson, Welders Department:

"I like it a lot. ... I like that there's less people there, there's less people to work around, you don't have as many people going through your job area when you're trying to work. ... Traffic's definitely better, especially getting out. You don't have so many people leaving the parking lots. Parking, you can get right in. I don't have to park four blocks away. That's definitely a big benefit."

Photos courtesy of Northrop Grumman Shipbuilding

The Critical Second Tier

SUBMARINE VENDORS

The term "submarine construction industrial base" brings to mind the massive shipyards of General Dynamics Electric Boat and Northrop Grumman Newport News Shipbuilding. But critical components of America's submarines have always come from the second tier of the construction industrial base — the many specialized manufacturers who supply key products to the shipyards.

These "vendors," as they are called, are as important to the success of any submarine building program as the yards themselves. As submarines have grown more complex and sophisticated, the variety of vendors has increased, and the level of expertise they must bring to the table has steadily risen. Consequently, they contribute more than ever to ensuring quality, providing innovative solutions, and controlling costs.

John D. Holmander, the Electric Boat vice president responsible for the *Virginia* (SSN-774)-class submarine program, neatly summarized the critical role played by these varied suppliers:

"The vendor base is responsible for about a third of the cost of a *Virginia*-class submarine, so we depend on our suppliers for innovation, imagination and product and process improvement. The support we get from [vendors], which take that responsibility seriously, enables us to build the world's best submarines at the lowest possible price."

UNDERSEA WARFARE does not begin to have enough space to describe the many capable firms that make up the submarine vendor base. Even a bare listing of their contributions and major achievements could take up many pages. So rather than attempt to capture the entire vendor base, the following articles briefly describe the achievements of two specific companies in order to give our readers some idea of how vendors contribute to building successful submarines.

Each of these two representative companies—Seemann Composites Inc. and Target Rock, a unit of the Curtiss Wright Flow Control Company — has its own unique story, but in a broader sense, they stand for the entire community of capable manufacturing organizations that help America's two major submarine builders turn out the world's best submarines.

SEEMANN COMPOSITES, INC.

Building Large Composite Structures on Mississippi's Gulf Coast

by David Tortorano

Hurricane Katrina made landfall on Mississippi's Gulf Coast on Aug. 29, 2005, causing immense damage throughout the region. In the hot, humid days that followed, workers at Seemann Composites, Inc. (SCI) on the Bernard Bayou Industrial Seaway in Gulfport, Miss. swept out the debris and mud brought in by the four feet of salt water that flooded the plant during the storm. Led by company president Bill Seemann and plant manager Randy Bardwell, they worked long hours to get back into operation, while at the same time Seemann and many of his workers had to deal with damaged or lost homes.

The Seemann Composites facility in Gulfport, Miss. At top right is a waterway providing access to the Gulf.

It may not be too much of an overstatement to say that managers and workers were battle-tested like the military services they help equip. They did what it took to get up and running again with no delay whatsoever in scheduled deliveries. Ten weeks later, they were back in full production. "Because we acted quickly," Seemann recalled, "we mitigated our losses and got back into production quickly. We were able to meet our schedule."

In fact, the company went on to add production capacity. In 2009, it installed a new computer-numerical-control (CNC), high-accuracy, five-axis gantry router that does close-tolerance machining with aerospace-quality accuracy and can machine pieces as large as 100 feet by 20 feet by 10 feet.

From its start as a small boat builder 40 years ago, SCI has grown into a highly specialized developer and builder of cutting-edge components for the defense industry. It now employs just over 100 workers. Its 15-acre facility includes 400 feet on a waterway with access to the Gulf, enabling it to ship large products anywhere in the world. Two buildings totaling over 100,000 square feet of manufacturing and office space contain several million dollars worth of state-of-the-art equipment.

Military products account for virtually

Seemann's CNC high-accuracy, five-axis gantry router.

all of SCI's work, including components for systems that operate on land, in the air, and on and beneath the sea. Customers include a variety of organizations in the Navy and Army, as well as NASA. Its commercial customers include the cutting-edge specialty firm Materials Sciences and defense industry giants like General Dynamics, Northrop Grumman, Lockheed Martin, Boeing, Raytheon, and Textron.

A large part of SCI's work is devoted to supplying half a dozen components for the *Virginia*-class attack submarine. Like many other submarine subcontractors, the company serves not just as a reliable supplier but also as a center of manufacturing innovation. "Excellence through Innovation" is the motto that appears in its logo, and finding better ways to do things has accounted for much of its growth. Its particular expertise is in developing composite components to replace the metal ones on submarines. This on-going innovation has helped reduce cost and improve performance for the *Virginia* class and has the potential to do the same for future programs.

When Bill Seemann started building fiberglass boats back in the mid-1960s, he thought there had to be a better way to build laminated structures than the traditional hand-laid, open-molding method, which was labor-intensive and posed environmental and health risks, so he began experimenting. Two of his innovations in particular would shape the company's course. Both contributed to a molding process that permits the fabrication of large, high-quality pieces from composite materials at reduced cost.

The first innovation, in the 1970s, was C-Flex, a method for building with fiberglass without using a mold. Twenty years later, he developed and patented the vacuum-infusion method he called SCRIMP, which stands for Seemann Composites Resin Infusion Molding Process. SCRIMP greatly reduced volatile organic compound emissions. It produced consistent results with low-cost tooling, and it permitted the fabrication of structures with no practical size limit. SCRIMP is now used worldwide to fabricate everything from ground vehicles to aircraft structures.

The first customer for the SCRIMP method was the Naval Surface Warfare Center, Carderock Division, for which SCI built a test module for the Advanced Technology Composite Deckhouse program. This work paved the way for supplying high-quality composite parts at a price that was affordable for large-scale structures on Navy ships — including submarines. How far composites have come is indicated in part by the products being made with them. It's hard to find a more grueling environment than the high-pressure world where submariners operate.

SCI shipped the first item for the *Virginia* program in 2000, and by 2010, it had supplied components for eight submarines of that class. The company first got involved in the program a decade ago, when it started work on components of the precursor to the Light Weight Wide Aperture Array (LWWAA), the advanced acoustic detection system located on the submarine's hull.

LWWAA components remain the company's largest submarine product line. Using SCRIMP and a proprietary super-toughened vinyl-ester resin called STVE5, SCI builds the fiberglass Array Support Plate as well as the fairings for the six LWWAA components on each submarine. It delivers the LWWAA components machined and with coatings and titanium hardware in place, ready for the electronics integration. It also builds other fiberglass components for the *Virginia* class, including the snorkel fairing, sail access covers, strainer plates, flood grates and dihedral cover.

The company's efforts have contributed significantly to the cost savings that are a hallmark of the *Virginia* class. In constant dollars, the cost for LWWAA components fell more than 23 percent between ship set 1 and ship set 11. Increased efficiencies resulting from the building of two subs per year rather than one subsequently reduced the cost by another 14 percent for ship sets 12 through 18. In broader terms, the trend toward replacing metal parts with composites has also yielded weight savings, and it has increased resistance to corrosion, which helps to reduce life-cycle cost.

SCI is now developing a composite sail cusp, tail-cone and bow dome. After a two-year competition, it was chosen to participate in the Composite Advanced Sail program for the *Virginia* class. Working with the Naval Surface Warfare Center (NSWC), SCI fabricated full-scale test sections of the Advanced Sail, which validated the structural analysis techniques developed by NSWC.

The company is also working with NSWC to develop a lower-cost manufacturing process for the composite bow dome on *Virginia*-class subs. The current manufacturing process, which uses aerospace pre-preg (pre-impregnated) laminates cured in an autoclave, limits the size of a composite bow dome to the diameter of the autoclave. SCI developed an out-of-autoclave method using SCRIMP and low-cost tooling to overcome the size limitation.

This is of particular interest to submarine builders with the need to replace the *Ohio*

(SSBN-726) class looming on the horizon, requiring a bow dome that will exceed the size of current autoclaves. SCI has built multiple test pieces to qualify the manufacturing concept and is in the process of building a full-scale prototype bow dome projected to yield cost reductions on future procurements, not to mention saving the cost of building an autoclave large enough to cure the new dome.

"Seemann Composites hopes to be continually supplying composite components for the *Virginia*-class program for as long as they are being built," said Seemann, adding that the company is actively developing new materials that will advance the state of the art in submarine composite structures.

Mr. Tortorano heads Tortorano Commissioned Publications, a research firm that provides documentation for organizations' internal use and for print and electronic publication.

TARGET ROCK
How a Vendor Helps Keep the *Virginia* Class Affordable

by Daniel Wynn

As a key part of its effort to increase the submarine build rate from one to two ships per year, the U.S. Navy challenged the submarine industrial base to reduce the cost of *Virginia*-class submarines by 20 percent. The very decision to double the number of submarines funded each year would achieve real savings through economies of scale. However, increased volume alone would not be sufficient to achieve a 20-percent reduction. A significant cost gap still existed.

Every company in the submarine industrial base would have to do its part to close that gap. Target Rock, a business unit of Curtiss Wright Flow Control Company based on Long Island, in Farmingdale, N.Y., took an aggressive and systematic approach to cost reduction. This included significant investment in equipment that could speed up production and reduce waste and rework. It also included continuing review of procedures to eliminate any procedure that added cost without improving quality or capability.

Target Rock designs and manufactures a significant percentage of the valves in the *Virginia* class. Its products are in the nuclear power plant, in the engine room, and in Level I/SUBSAFE ship service systems. Curtiss-Wright Flow Control has long fostered a culture of continuous improvement and cost reduction, so it challenged its team to design a solution.

Through it all, the company had to remember its ultimate customer: the crew that would take the submarine into harm's way defending the nation. The crew would need to focus on the mission, not on whether they could rely on equipment Target Rock provided, so no change the company made could be allowed to adversely affect the quality and performance of the equipment.

"Done in One" machining centers are a key contributor to efficiency and cost reduction at Target Rock.

With that in mind, the company still needed to adhere to the principle of constructive dissatisfaction. It needed to review what it was doing, why it was doing it, and ask, "Is there a better way?"

Design changes and requirement reductions are key ways to reduce costs. Target Rock set up a formal program with its customers to identify potentially cost-effective design changes and to target requirements that added little or no value. The program developed a prioritized list of possible cost-saving initiatives and a business case to evaluate them in terms of how much investment they would require, how much technical risk they would involve, and how much savings they could generate. The goal was to maximize the overall return on investment in order to achieve the greatest possible savings for the *Virginia* class.

This program resulted in a number of changes that significantly affected cost. They included eliminating some reporting requirements, reducing unnecessary non-destructive tests, changing materials, and revising processes and drawings. However, Target Rock did not then declare victory and move on. Controlling costs is not a one-shot proposition. It is an iterative process that requires continuing effort. Consequently, the company continues to work the priorities and add ideas today.

Manufacturing parts is a significant cost in the valve business. The company began to address this cost by streamlining processes and by reviewing defects with an eye to eliminating rework. Some parts require set-up through several machining centers that do turning, milling, etc. Each set-up requires a certain number of hours. The company identified a way to move as many parts through the work center as practical before changing the set-up. With the set-up time remaining the same, and the number of parts increasing, this reduced the set-up cost for each individual part.

However, this promising approach failed to achieve the anticipated savings because it completed many parts long before they were needed, and that interfered with savings from just-in-time delivery farther downstream. Clearly, the company needed to come up with a different approach.

Target Rock found the solution in the latest machine tool technology—what are known as "Done in One" machining centers. These machines have dual spindles, turning and milling capability, multiple pallets, and a wide assortment of tools in the carriage. Investing several million dollars in this technology would enable the company to run a

wide variety of parts from start to finish in a single operation, even in very small lots, with minimal to no set-up time. The new machines that make this possible are now running, and workers are being retrained to operate them.

Unlike set-up hours, welding hours were not a significant factor in the cost of Target Rock's products, but dealing with welding defects could significantly affect both cost and schedule. The Navy's welding standards, requirements and controls are quite extensive because the quality of welding is absolutely critical to the performance of the equipment. With all of the procedures and process controls, the single largest variable in welding is consistent workmanship by the welder.

Target Rock set out to increase consistency by automation. Over the past several years, it has introduced mechanized Plasma Transferred Arc (PTA) and Gas Tungsten Arc (GTA) welding equipment. This has greatly increased consistency for parts with a geometry that lends itself to the new equipment. The company is now evaluating several alternatives to expand this initiative, including the use of robotic welding machines.

In the assembly department, Target Rock has moved to modular construction. The company looked at the movement of components through the facility and set up specific work cells for various subassemblies with tooling and fixtures readily available. This has streamlined assembly significantly. Further reviews to enhance efficiency, which are known as lean process reviews or "Lean events," are planned for 2010.

Target Rock also has several high-pressure and high-temperature test facilities, which are expensive to operate. The company looked at how to reduce test set-up time at facilities of this sort. What it discovered was that technicians were expending a significant effort reconfiguring test loops for different valve styles. The company invested in additional instrumentation, leaving set-ups permanently in place in different facilities, which reduced loop breakdown and set-up time. The resulting savings paid for the investment in instrumentation in less than six months.

Another key area for savings is the supply chain. Raw material and supplies are significant costs. Curtiss Wright Flow Control set up a Supply Chain Leadership Team consisting of the purchasing managers from all of its business units. One of the team's initiatives was to leverage purchasing across all of the business units. The resulting volume buys drove down the cost of raw material and supplies.

The company has also challenged suppliers to be part of the solution. Small businesses can achieve substantial savings in the manufacture of certain components. However, Target Rock realizes that small firms may not have the sophistication needed to understand all of its requirements. It may have to collaborate very strongly with some suppliers to achieve savings while continuing to meet the rigorous standards of the Submarine Force.

At Curtiss Wright Flow Control, lean process reviews and other cost reduction efforts are company-wide; they don't stop at the factory floor. Target Rock's engineering group reduced customer interface costs related to the submission and approval of documents. Its planning department reviewed planning, requisition and receiving processes to reduce cycle time and improve reporting.

Similarly, the contract department conducted a Lean event on the company's contract and amendment review process, dramatically reducing the time required to process amendments, get new instructions in place and get acknowledgments back to its customers. The company is currently running Lean events in accounting, to improve its monthly, quarterly and year-end close processes, and in engineering and purchasing, to improve the supplier interface on vendor procedure review and approvals.

All of these efforts have positioned Target Rock to offer pricing to support the goals of the *Virginia* program. While the company has made significant progress, it recognizes, as noted earlier, that this must be an ongoing process, with all involved consistently practicing the art of constructive dissatisfaction and continuous improvement.

Curtiss Wright Flow Control Company takes great pride in its contributions to the *Virginia* class, but this is no time for any firm to rest on its laurels. The *Virginia* class Block IV, comprising hull numbers SSN-792 and beyond, is imminent, and the submarine industrial base is just getting started on the *Ohio* replacement. The current economic turmoil is putting tremendous pressure on defense funding of all sorts, and the submarine industrial base must remain keenly aware of the need to give excellent value in return for the expenditure of American tax dollars.

The *Virginia* class is the model for effective defense acquisition. Its success results from skillful management on the part of the Navy, the shipyards, and the submarine vendors that supply them. But it also rests on the ability of every employee of a submarine vendor to demonstrate that their work in the machine shop, on the assembly floor or at the planning desk not only helps produce the most capable warship ever designed, but helps keep it affordable.

Automated welding produces high-quality parts.

Mr. Wynn is the vice president of defense business at the Target Rock business unit of Curtiss Wright Flow Control Company.

by Submarine Group Two Public Affairs, PEO Submarines Public Affairs, and Olivia Logan

TWO Commissionings Make 2010 a Banner Year

The commissioning of USS *New Mexico* (SSN-779) in late March and USS *Missouri* (SSN-780) at the end of July made 2010 only the second year since 1996 that the Navy has commissioned two submarines of the same class.

"We will commission two submarines this year because the Navy and its industrial partners are delivering boats ahead of schedule," said Rear Adm. William Hilarides, the former Program Executive Officer for Submarines. *New Mexico* was delivered seven months earlier than the contract delivery date, while *Missouri* was delivered in only 65 months, nine months ahead of the contract delivery date.

"The *Virginia* program," Hilarides added, "is fulfilling its primary requirements of getting this needed capability to the fleet as soon as possible and is on track to meeting our stated goal of reducing its construction span to 60 months by fiscal year 2012."

New Mexico, the sixth submarine of the *Virginia* class, and *Missouri*, the seventh, joined the fleet with all the pomp and spectacle of traditional commissioning ceremonies. Distinguished speakers spoke words of welcome, crewmembers ceremonially boarded the new ships, and the latest *Virginias* embarked on their service lives with well wishes from citizens of their namesake states and the appreciation of the American people as a whole.

Defendemos Nuestra Tierra

USS New Mexico Comes to Life

The U.S. Navy welcomed the newest member of the state-of-the-art *Virginia* class, USS *New Mexico* (SSN-779), in a March 27, 2010, commissioning ceremony at Norfolk Naval Station in Norfolk, Va. Among the roughly 3,000 guests invited to witness the commissioning were senior Navy officials, national and state legislators, and former Secretary of Defense Donald Rumsfeld, who owns a ranch near Taos, N.M.

Director of Naval Reactors Adm. Kirkland Donald delivered the principal address. Cindy Giambastiani, the submarine's sponsor and wife of retired Joint Chiefs of Staff Vice Chairman Adm. Edmund Giambastiani, gave the time-honored order, "Officers and crew of *New Mexico*, man our ship, and bring her to life!" The crew then ran aboard, marking the sub's official entry into active service.

New Mexico Commanding Officer Cmdr. Mark A. Prokopius leads a crew of approximately 134 officers and enlisted personnel. Current and future crewmembers will continue to honor the ship's Spanish motto, "Defendemos Nuestra Tierra" (We Defend Our Land), for the next 30 years. In June, the submarine proceeded to her homeport at the Naval Submarine Base in Groton, Conn.

New Mexico was built under a unique partnership between Northrop Grumman Shipbuilding and General Dynamics Electric Boat. Under that partnership, the two yards are now scheduled to build at least 12 more *Virginia*-class submarines for the Navy. *New Mexico* is the third boat to be delivered by Northrop Grumman's Newport News shipyard.

Photo by Petty Officer 3rd Class Christian Martinez

The sub's keel was authenticated in April 2008, followed by a christening in December. It took 1,300 shipbuilders over five years to build her. After completing her sea trials in the fall of 2009, she was delivered to the Navy in December, four months ahead of schedule — and with one million fewer man-hours than her predecessor from Northrop Grumman Shipbuilding, USS *North Carolina*. After two sets of sea trials, *New Mexico* required no major repairs or alterations.

"We're all excited," said Kay Weisskopf, a rigging general foreman with more than three decades at Northrop Grumman Shipbuilding's Newport News shipyard, which built the sub. "Any time we finish a quality product ahead of schedule and with [reduced man-hours], that's a great thing to be proud of."

Although the Newport News shipyard built its first submersible roughly a century ago, its role as a major submarine builder began 50 years ago, when it launched the *Robert E. Lee* (SSBN-601), America's fourth strategic ballistic missile submarine. "That officially began our long partnership with the United States Navy's submarine program," Matt Mulherin, general manager of the Newport News shipyard, said at the commissioning. "Building submarines is an important part of our tradi-


Photo by John Whalen, NGSB


Photo by Alan Baribeau

tion at Newport News."

Thanks to residents of the "Land of Enchantment," reminders of *New Mexico*'s ties to the 47th state appear throughout the boat. Bunk curtains with an Aztec print were made in the city of Las Cruces, N.M. Albuquerque resident Emilee Sena designed the ship's crest in 2007, placing representations of a New Mexico sunset, the Sandia Mountains, and the Zia symbol from the state's flag around a drawing of the submarine.

"I was a senior in high school and never thought of the importance and the impact my painting would have," said Sena. "I am proud of being part of this submarine and the life of the Sailors on board who defend our country."

"Even though we're a long way away in New Mexico, and we'll never get the sub up the Rio Grande to visit us, this is very important to us, and we're very happy," noted Dick Brown, chairman of the *New Mexico* commissioning committee. "It's just a great honor for the state of New Mexico."

Even the ship's galley has a New Mexico flare. It is affectionately known as "La Posta," after a famous 70-year-old restaurant in Mesilla, N.M., which is currently owned by retired Navy Capt. Tom Hutchinson. La Posta won the honor 18 months ago in a statewide competition with other restaurants.

"We've had several mess specialists visit New Mexico and work side by side to learn our recipes," said Hutchinson. "They're underway six to nine months at a time. Every other week, they'll have La Posta night, and they'll prepare a lot of our dishes." In addition to donating recipes, La Posta presented the ship with a $1,200 check from the sale of *New Mexico* items in the restaurant's gift shop.

The only other ship named after the state was a battleship (BB-40) that was in service from 1918 to 1946. Battleship *New Mexico* earned six battle stars in World War II service and provided shore bombardment support for landings in the Gilbert and Marshall Islands, and at Guam, Tinian, Saipan, the Philippines, and Okinawa.


Photo by John Whalen, NGSB

(Opposite) Sailors assigned to USS *New Mexico* (SSN-779) run to the *Virginia*-class attack submarine after getting the order to "bring the ship to life" during a commissioning ceremony. *(Top left)* Director of Naval Reactors, Adm. Kirkland Donald delivers the ceremony's principal address. *(Top right) New Mexico* ready for her commissioning ceremony at Naval Station Norfolk on March 27, 2010. USS *George H.W. Bush* (CVN-77) can be seen in the background. *(Above)* Cindy Giambastiani, the wife of Adm. Edmund Giambastiani, USN (ret.), served as ship's sponsor and gave the traditional order to "man our ship and bring her to life."

Today's *New Mexico* carries some mementos from her predecessor. In 1917, the New Mexico state Senate commissioned Tiffany & Co. to make a 56-piece sterling silver set for the battleship's wardroom. After BB-40 was decommissioned, the Navy returned the set to the state. It is now in the collection of the New Mexico State History Museum at the Palace of the Governors in Santa Fe, and the museum has loaned the submarine two dessert plates, each engraved with a scene from the state.

The sixth member of the *Virginia* class, *New Mexico* is 377 feet long, displaces 7,800 tons and is armed with Tomahawk cruise missiles and MK-48 torpedoes. She can dive to a depth in excess of 800 feet and operate at speeds in excess of 25 knots while submerged.

Like other members of her class, *New Mexico* is designed to dominate both littoral and deep water and conduct special operations; intelligence, surveillance, and reconnaissance; irregular warfare; and mine warfare missions. She is the first of her class to go into commission fully certified in anti-submarine warfare, anti-surface ship warfare and strike. Her intrinsic stealth, endurance, firepower, and sensor capabilities enable her to directly support five of the six core capabilities of the Maritime Strategy: sea control, power projection, forward presence, maritime security, and deterrence.

The Next MIGHTY MO Joins the Fleet

Under sunny skies, nearly 3,000 invited guests witnessed the commissioning of USS *Missouri* (SSN-780) July 31 at Naval Submarine Base New London, in Groton, Conn. *Missouri* is the newest boat of the *Virginia* class and the fourth American warship to bear the name of the "Show Me State." Becky Gates, the submarine's sponsor and wife of Secretary of Defense Robert M. Gates, gave the traditional first order, "Man our ship, and bring her to life."

Missouri had aced her Alpha and Beta sea trials earlier in July. Departing Groton July 2 for her Alpha trails, her crew evaluated the ship's capabilities through several different testing evolutions, including diving to test depth, conducting an emergency surfacing and testing the propulsion plant. The submarine returned to Groton July 4 ready to begin her Bravo sea trials the following day.

"*Missouri* and her crew lived up to our highest expectations," said Capt. Michael Jabaley, program manager for the *Virginia* class. "Cmdr. [Timothy A.] Rexrode and his team performed flawlessly and were constantly ahead of schedule. The material condition of the ship was outstanding, a testament to the quality of its construction, allowing us to perform a rapid turnaround and get the ship back out on Bravo trials the next day."

The keynote speaker at *Missouri*'s commissioning, Rep. Ike Skelton of Missouri, Chairman of the House Armed Services Committee, said of the ship, "There is none better. This amazing submarine and the other submarines of this class are vital to our national security." Secretary of the Navy Ray Mabus and Chief of Naval Operations Adm. Gary Roughead also spoke at the ceremony.


Photo by Olivia Logan

The building of *Missouri* commenced in December 2004. Her keel was authenticated in a Sept. 27, 2008, keel-laying ceremony at Electric Boat's North Kingstown, R.I., facility. Becky Gates christened the boat by breaking the traditional champagne bottle against her sail in a late-morning ceremony at Electric Boat's Groton Shipyard Dec. 5, 2009. On April 16, 2010, the submarine's "In Service Day," crew members moved aboard, brought her systems to life, and began general day-to-day operations in preparation for the usual pre-commissioning sea trials and work-ups.

Cmdr. Rexrode, *Missouri*'s commanding officer, who hails from Spencer, W. Va, leads a crew of approximately 134 officers and enlisted men. They include five native Missourians: Petty Officer 1st Class John M. Tyhurst, of Joplin; Seaman Benjamin A. Bowers, of Green Ridge; Lt. Patrick Donovan, of Springfield; Petty Officer 2nd Class Nicholas C. Koblick, of St. Louis; and Petty Officer 2nd Class Ryan J. Thruston, of Jefferson City.

Citizens of Missouri played a central

Photo by John Narewski

(Left) Cmdr. Timothy Rexrode, *Missouri*'s commanding officer, fields questions from the media in the control room of the submarine during Media Day, two days before the commissioning ceremony. *(Right)* Master Chief Petty Officer of the Navy (MCPON) Rick West visits *Missouri* the day before her commissioning to award 15 Sailors the Dolphin insignia, signifying qualification in submarines.

role in the USS *Missouri* Commissioning Committee, an IRS-designated 501(c)3 nonprofit charity created to increase awareness of the submarine's commissioning. In partnership with Grantham University, the Commissioning Committee presented a four-year full scholarship to one of the "plank owners" in *Missouri*'s commissioning crew.

Retired Rear Adm. Karen Harmeyer, a member of Grantham University's Board of Directors, presented the scholarship to Petty Officer 1st Class Joseph Amick during the commanding officer's reception hosted by the committee in Mystic, Conn., the evening before the ceremony.

The scholarship, which can be used to earn an undergraduate or graduate degree at Grantham, covers tuition, required textbooks and software, and a laptop computer. "This is a perpetual scholarship," said Harmeyer. "There will always be one scholarship available to a member of USS *Missouri*'s crew. What better way to grow our leaders of tomorrow."

Interestingly, each of the previous American warships that bore the name *Missouri* has been one of the most advanced and powerful fighting ships of its time. The first, a frigate equipped with paddle wheels, helped usher in the age of the steam propulsion for warships. The second was one of the revolutionary ironclads built by the Confederacy during the Civil War. The third was BB-63, one of the famous *Iowa*-class fast battleships. It was on the deck of the third *Missouri* that Fleet Adm. Chester Nimitz, Gen. Douglas MacArthur, and other senior U.S. and Allied officers gathered on Sept. 2, 1945, to accept the unconditional surrender of the Japanese Empire, bringing World War II to an end.

The Navy's newest attack submarine, a powerful "battleship" of today's fleet and a worthy successor to her famous forebear, is currently homeported at Groton.

(Opposite, top) Sailors march toward *Missouri*'s brow to set the first watch, formally beginning her life as a commissioned ship. *(Opposite, bottom)* The crew of USS *Missouri* (SSN-780) man the rails and bring the ship to life following commissioning at Naval Submarine Base New London. *(Below)* *Missouri* Congressman Ike Skelton, principal speaker of the commissioning, addresses the crowd. On stage with him are (from left to right) Secretary of the Navy Ray Mabus, Connecticut Congressman Joe Courtney, Missouri Governor Jay W. Nixon, Connecticut Governor M. Jodi Rell, *Missouri* Commanding Officer Cmdr. Timothy A. Rexrode, ship sponsor Mrs. Becky Gates, Chief of Naval Operations Adm. Gary Roughead, and Commander, Submarine Forces, Vice Adm. John J. Donnelly.

by Olivia Logan

Peanut Butter Pizza and Five-Star Service

The USS Providence *Award-Winning Culinary Team*

Crab legs? Check. Pizza? Made to order. Soft-serve ice cream? No problem. Is this a run-down of the food that's available on a seaside boardwalk? No, just some of the fare onboard USS *Providence* (SSN-719).

In 2010, the USS *Providence* (SSN-719) culinary team took home the Capt. Edward F. Ney Award for excellence in food service for the second year in a row, The winners accepted the award at a ceremony in Reno, Nev., on April 17. The ship competed against all other boats in the Submarine Force. USS *Wyoming* (SSBN-742) (Blue) was runner up, and USS *Ohio* (SSGN-726)(Blue) received honorable mention.

UNDERSEA WARFARE Magazine spoke with two members of the award-winning team to find out their ingredients for success. No secret spices here, just hard work (and maybe a little hot sauce thrown in for good measure).

Photo by Olivia Logan

There is no culinary training specific to submarines. "It's generic," said Petty Officer First Class Devin Morava. The cooks learn the basics of food preparation and line cooking, "but no submarine training." On the other hand, Seaman Jaron Holliday, another member of the team, did go to school for food service prior to joining the Navy.

In the galley, the leading culinary specialist and the supply officer are responsible for food planning. The menu follows a three-week cycle, similar to that of a cafeteria calendar. "All the subs pretty much run off that three-week menu," said Morava. But there is some leeway with what they can prepare. "Certain meals are made on crew preference. Like it will say, 'chicken,' and you can make what you want with chicken on that day."

The menu is protein-based and varies depending on where the sub and her crew are located and where they can obtain food. Shelf life and sustainability are very important for a vessel that can be out to sea for months at a time. The culinary specialists said perishable items like produce and milk have a maximum shelf life of two weeks. After that, they move on to things like Jell-O and canned goods. As for frozen food, they carry 90-days worth. But you won't find any convenience food onboard. According to Morava, there are "no TV dinners on a sub."

Asked if any particular food is off limits, Morava said not really. "Each region has a different [food] catalog. All the boats have the ability to order the same thing. It is their preference to order what they would like." As for items that will definitely be off the menu, "no squid or lamb," he said.

When it comes to the actual meals, "95 percent are cooked onboard," said Morava. There are some things that are precooked, such as presmoked ribs, but many items are made from scratch, including their own hamburger buns!

The amount of food the culinary team prepares depends greatly on whether the sub is in port or at sea. "One third of the crew stays onboard while in port, so the evening meal will be smaller," explained Holliday. "But out to sea, everyone stays, so everyone eats." Knowing that everyone will be eating tells the cooks exactly how much food to make. "While you are in port, you have the opportunity to go out and get food," added Holliday. Out to sea? They make do with what they have.

And, ship motion can make cooking for about 130 people in a tiny galley pretty tricky, what with cake-spills in the oven, eggs running across a slanting grill, oil on the floor that should be in the fryer and other messes. "We have a pretty good crew," said Morava, "They understand ... most of the time."

The culinary team faces quite a few other routine challenges. "There's not a lot of space," said Holliday. Only one cook at a time can be in the galley. "Two is possible," said Morava, "but they start bumping into each other, and it gets crowded."

Holliday mentioned that time is important in meal prep. "You have to have the meal

(Above, left to right) Fresh fruit is available in the galley. (Good nutrition is important; every meal is required to have a healthy option.) Dessert for a distinguished visitor luncheon: Cereal-Crusted Ice Cream Balls (cookies and cream ice cream combined with Cinnamon Toast Crunch and finished with a chocolate and caramel drizzle). A member of the culinary team prepares the famous Wicked Chicken. (Photos by Olivia Logan)

done by a certain amount of time and before that ... so the cooks can eat," he said. The galley serves every six hours when underway — four meals in a 24-hour period. Holliday also mentioned drills and unexpected hiccups, like losing power on one side of the galley, that make preparing food on time difficult.

The logistics of eating on a sub are also a challenge. The meal is served buffet style, but due to the cramped space, not everyone can get up at the same time. It is often "one in, one out" in the mess hall. To cut down on the chaos and minimize the number of people standing in the access, every crew member is assigned days to come help serve the meal.

New crew members in particular do the dirty work, like washing dishes and scrubbing the decks. Morava and Holliday called them the "unsung heroes" of the food service operations. However, new crew members are often assigned to the sub only temporarily, so the "unsung heroes" who assisted in the winning of the Ney award have since moved on and are no longer working in *Providence*'s galley.

The cooks mentioned "Burger Day," which falls on a Friday, as one of the easiest cooking days. "Quick and easy, the crew loves it, and only a couple ingredients are required," explained Morava.

"Taco Tuesday" and "Wicked Chicken" are the sub crew's favorite meal days. On Taco Tuesday, the team prepares some sort of tacos, chimichangas or fajitas. Wicked Chicken is served every Wednesday. It is essentially buffalo chicken, called "wicked" because it is so hot and spicy.

On Sunday, the galley serves prime rib, steak, lobster or crab legs. On Saturdays, pork is served, followed by pizza as the midnight meal. Asked if they make all different kinds of pizza, the culinary specialists mentioned preparing peanut butter and cheese pizza. "If we have it, we'll make it," they said. Whatever floats your boat, so to speak.

The culinary team does their best to celebrate special occasions as they would on land. They often make cakes for crewmembers' birthdays, and they are allotted extra money to serve traditional Thanksgiving and Christmas meals.

In the end, the culinary team will do whatever they can to please the crew. According to Morava, "Food is one of the biggest morale things for a submarine. We get allotted a little [extra] chunk of money that the rest of the Navy does not." So, UNDERSEA WARFARE asked, would *Providence*'s consistent hard work pay off again in 2011's competition? The answer: "We're trying to go for a three-peat!"

Providence received honorable mention in the 2011 Ney Award competition's submarine category. USS *Maryland* (SSBN-738) (GOLD) took first place, with USS *Olympia* (SSN-717) following as runner-up. While not quite the hoped-for "three-peat," a third straight year of recognition as one of the top three submarine galleys is still a great tribute to the remarkable skill and dedication of the *Providence* culinary team.

Olivia Logan is managing editor of UNDERSEA WARFARE magazine.

(Opposite) Lt. j.g. Allen Hamby, *Providence*'s Supply Officer, sets the ward room table for a luncheon with a distinguished visitor. What was on the menu? Wicked Chicken, of course.

(Right, top) During a visit to Naval Submarine Base New London in April, Adm. John C. Harvey, Commander, U.S. Fleet Forces Command, presented the 2010 Ney Award for Food Service Excellence to the culinary specialists of USS *Providence*, represented by Petty Officer 1st Class Devin Morava, center, and Petty Officer 2nd Class José Rosarivas, right.

(Right, bottom) The pantry aboard USS *Providence*.

by William Kenny

AN UP-CLOSE LOOK AT THE SUBMARINE ESCAPE TRAINER

In November 2009, the Naval Submarine School opened the Submarine Escape Trainer (SET), which is dedicated to the achievements and memory of Vice Adm. Charles "Swede" Momsen. The opening marked a return to pressurized submarine escape training (PSET) after nearly three decades without it.

Addressing an audience of local community leaders and waterfront Sailors, the guest speaker, Rear Adm. Paul J. Bushong, then commander of Submarine Group TWO, made the following observation:

"Submarine Escape is a necessary skill [that] all of us hope to never need and to never need to use, but this facility and its talented staff are our guarantee that should that need arise, tomorrow's Undersea Warriors are ready for any challenge in every environment in which our Submarine Force operates, today and tomorrow."

At the core of this eighteen million dollar trainer is an 84,000-gallon pool, 20 feet in diameter and 40 feet in height, which sits atop escape trunks called the lock-out trunk (LOT) and the logistics-escape trunk (LET). This complex simulates the conditions a submariner would experience during an escape from a submerged submarine.

Pressurized submarine escape training takes two days and is both extensive and intensive. The morning of day one is devoted to verifying the medical records and medical history of the Sailors to ensure that no one with a health-related issue is put under pressure. The majority of medical issues identified are, in fact, temporary (head colds, allergies, etc.), so the students who suffer from them can return at a later date to receive pressurized training.

Sailors waiting for medical screenings receive an orientation and interactive overview in the form of a submarine onboard training (SOBT) tool that reviews the entire process of escaping from a disabled submarine.

The first afternoon, the class is divided into two groups. One group, Sailors who did not pass the medical screening for PSET, receives raft training. This consists of donning the MK 10 Submarine Escape and Immersion Equipment (SEIE) suit, getting into the life raft and de-watering it. The raft is flipped, and the students must get out from under it, surface, and flip the raft right side up.

The second group enters the recompression chamber and conducts a pressure test. These Sailors are pressurized to the equivalent of 60 feet of sea water (on air) to verify that their ears can handle the pressure and to let them experience what pressurization feels like.

Both groups then muster together and receive instruction on submarine escape. They go down to the escape trunks and receive a brief on what an escape is like from inside the trunk.

Only those medically screened for PSET return for day two; the rest get credit for unpressurized training. On the morning of day two, the remaining students receive raft training. After lunch, they practice escaping from the 15-foot lock. For the escape, they wear an inflatable training life jacket and experience what it would feel like if their SEIE suit hood failed and their faces were in the water on ascent.

After successfully completing that escape, they are ready to conduct an escape from 37 feet. Before they are released to enter the trunk, an instructor demonstrates everything they will have to do and answers all of their questions.

The Sailors don SEIE suits, and each one enters the trunk individually, accompanied by an instructor. As soon as a sailor gets into the trunk, he shuts the hatch, plugs in and zips up the hood. The instructor attaches the tether to the ladder as the student plugs in, and the SEIE suit immediately starts inflating. The hatch

Photo by Petty Officer 1st Class Jennifer Villalovos


Photo by William Kenny

(Opposite) A Sailor trains in the submarine escape trainer at the Navy Submarine School at Naval Submarine Base New London. *(This page, clockwise from top)* Basic Enlisted Submarine School (BESS) Fireman Apprentice Dominic Davis gets a full orientation and overview on submarine escape training long before he ever needs to don his submarine escape immersion equipment (SEIE) and get wet; Blink and you miss it! A Sailor rapidly ascends from 37 feet to the surface during pressurized escape training at the Submarine Escape Trainer; A student learns to properly ascend from 15 feet to the surface in a submarine escape trainer evolution; Petty Officer 1st Class Jesse Stas (left) and Petty Officers 2nd Class Chance Griffith (center) and Michael Gartman assist a BESS Sailor as he prepares to egress from the 15-foot LOT.


Photo by William Kenny

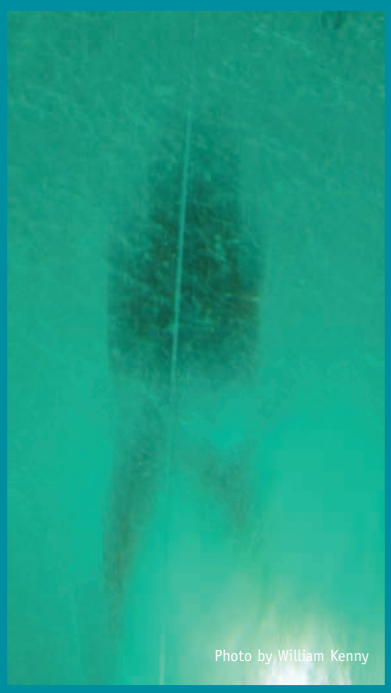


Photo by William Kenny


Photo by Petty Officer 2nd Class Jhi Scott

floods and pressure is equalized. When the hatch opens, the Sailor slowly rises, almost like a balloon, until the tether is taut.

The two instructors inside the escape tank take control of the Sailor and attach him with a second tether to the center line, which goes straight up to the top of the tank. That tether keeps the Sailor from accidentally bouncing off the side of the tank during ascent, but it doesn't slow him down. (In an actual escape, the ascent rate is 10.42 feet per second.)

Outside the trunk, the Sailor receives an OK sign and says "HOOOYAHHH," As he says "HOOOO," the instructor releases the tether still attached to the ladder, letting the Sailor shoot to the surface unobstructed while saying "YAAAAAAH" (which ensures that he exhales all the way up).

Some 2,880 Sailors, including both officers and enlisted personnel, are projected to receive submarine escape training each year. As Rear Adm. Bushong said at the SET dedication:

"It has been a long journey from 'Swede' Momsen's diving bell to this facility and the submarine escape immersion equipment, SEIE, we use today. But it's all part of our relentless dedication to training innovation and excellence in support of the world's finest submarine service."

William Kenny is the public affairs officer of the Submarine Learning Center in Groton, Conn.

by Petty Officer 1st Class Kimberly Clifford

SCENE ONE, TAKE TWO
Hollywood on an SSGN

Photo by Paul Farley

The strategic ballistic missile submarine (SSBN) is the ultimate manifestation of the silent service, patrolling the seas as the most survivable leg of America's strategic nuclear deterrent. As SSBN-728, USS *Florida* served as a strategic asset for 20 years before undergoing conversion to a guided missile submarine (SSGN).

As SSGN-728, *Florida* remains a lethal deterrent of a different sort. She is armed with up to 154 Tomahawk cruise missiles, for precision strike, and her battle management center gives a deployed joint task force commander a command and control facility for handling a variety of tactical assets.

Florida now deploys for approximately a year at a time. With blue and gold crews alternating about every three months and voyage repair periods (VRPs) at Diego Garcia, she can remain mission-ready and forward deployed for approximately 70 percent of the year.

But that is not *Florida*'s only new mission. In the past year, she has also been tasked to represent the Submarine Force—with her crew members in the role of model submariners—in both a full-length Hollywood motion picture and a television episode for National Geographic's "Naked Science" series.

The full-length movie, whose working title is "I am That Man," is about U.S. Navy SEALs and their operations. The production team, a film company called Bandito Brothers, set out to make the movie as authentic as possible. While the script is fictitious, all of the actors are active-duty Navy personnel—the first time this has ever been done for a major motion picture. Navy Special Warfare (NSW) carefully vetted Bandito Brothers' ability to make a film that depicts actual NSW operations.

Florida's reconfiguration as an SSGN included the conversion of two of the original Trident missile tubes to lock-out trunks and the attachment of a dry deck shelter outside the pressure hull, all of which support the deployment of special operations personnel. The dry deck shelter houses the SEAL Delivery Vehicle (SDV), a type of mini-submersible. SEALs teams don their dive gear in the lock-out trunks, which are then flooded to allow them to man the SDV and perform their mission. *Florida* can carry up to 60 special operations personnel.

The film crew had five days onboard *Florida* to do the bulk of their filming. Cameras captured the narrow passageways, the glow of the gauges and dials in the submarine's control room, and the converted missile tubes that now serve as dive lock-out trunks. Briefings were held in the battle management center, and the SEALs launched their combat rubber raiding craft (CRRCs—which are small inflatable boats) for action-packed sequences on the ocean surface.

With the interior shots done, filming moved underwater, with the Sailors donning dive gear in the lock-out trunks and entering the dry deck shelter. The film crew used special underwater cameras to capture the flooding of the dry deck shelter and the launch of the SDV.

Hollywood people involved with the project were initially concerned about using Sailors at all, worrying that their lack of acting experience would lead them to recite their lines in a stilted fashion and make the film seem low-budget. But seeing what the Sailors could do put those fears to rest and convinced them to make real Sailors the film's main focus.

"Hollywood changed their tune. After realizing that no one can play a SEAL but a SEAL and seeing how well the actual Sailors performed while on camera, Hollywood wanted the public to realize that these men are not just great actors but the real thing, real operators doing real missions," said director Mike "Mouse" McCoy.

The Bandito Brothers movie will have no computer graphics or stuntmen. Real Sailors will be the stars and will be featured conducting the very operations they were trained to execute in defense of the nation.

The employment of real state-of-the-art equipment and actual Sailors has prompted the creation of a new movie rating of "A," which signifies that a film is authentic. The purpose of this new rating is to distinguish

(Opposite) Crew members conduct mooring operations as the *Ohio*-class guided-missile submarine USS *Florida* (SSGN-728) arrives for a routine port visit to the island of Crete. *(Above left)* USS *Florida* (SSGN-728) (B) Commanding Officer Capt. Randy Crites speaks with a film crew from Lone Wolf Documentary Group in the control room of the *Ohio*-class guided-missile submarine. *(Above right)* A Navy diver and special operator perform SDV operations with USS *Florida* (SSGN-728).

between a movie that uses true live-action scenes, like the ones involving *Florida*, and a movie that relies on computer-generated graphics for its action.

The new film about SEAL operations is expected in movie theaters in the fall of 2010.

Meanwhile, the Lone Wolf Documentary Group produced a television episode about *Florida* for the National Geographic series "Naked Science." This episode, entitled "21st Century Stealth Sub," took a close-up look at the weapons, technology, dangers, tests and triumphs of an SSGN and her crew.

The Lone Wolf production crew followed *Florida*'s Gold crew during off-crew training and then embarked with the Blue crew to film onboard footage. Covering both the off-crew training and life aboard the submarine enabled the film crew to depict the entire cycle of an SSGN Sailor.

Lone Wolf filmed the proficiency training portion at the Trident Training Facility (TTF) in Kings Bay, Ga., where it captured submarine Sailors in a variety of training scenarios. When a crew is not manning the submarine on deployment, they are honing their skills at TTF, which has 150 classrooms and laboratories. TTF's state-of-the-art simulators allow Sailors to train on the same equipment they use in the submarine, and with scenarios they might encounter while onboard.

The television production crew started filming in the ship control trainer, commonly referred to as the "Dive and Drive." Due to scheduling constraints, the *Florida* crew was unavailable for filming when the "Dive and Drive" was available, so the Blue crew of USS *West Virginia* (SSBN-736) did the honors, demonstrating the procedures for maneuvering an *Ohio*-class submarine in various situations, such as dive and emergency surfacing (emergency blow).

The television crew caught up with *Florida* crewmembers in time for them to demonstrate the Virtual Environment for Submarine Shiphandling (VE-Sub) trainer. VE-Sub is a virtual-reality type of trainer designed to train junior officers to navigate within various ports around the world. The student stands on a mock bridge, wearing a virtual reality helmet. The helmet display shows a 360-degree simulation of a harbor, piloting charts, a gyro compass and a virtual crew.

The instructor assigned to the trainer sits at a computer terminal that allows him to develop scenarios. He controls traffic patterns, visibility, time of day, weather, currents and even emergency situations such as a man overboard. The student has complete control of course, speed and rudder angles in order to react to the program situations.

After seeing the classroom side of training, it was time for the filmmakers to go to sea. Lone Wolf's cameraman embarked with *Florida* Blue as the submarine departed Kings Bay for deployment.

Cameras captured the Sailors conducting procedures for getting the submarine underway, including the surfaced transit that the crew had just practiced in the VE-Sub trainer. The production crew then transferred from *Florida* to a Kings Bay tugboat for additional shots of the submarine's transit.

A few days later the Lone Wolf crew flew to Souda Bay, Crete, to meet the submarine for an overnight embark. The film crew followed the commanding officer, the chief of the boat and multiple Sailors throughout the 24-hour period in order to accurately portray life aboard an SSGN.

A highlight of the embark was the dolphin ceremony, where a junior officer and junior enlisted crewmember were formally welcomed into the elite brotherhood of Qualified Submariners. The day that a submariner earns his dolphins is considered one of the most memorable moments of his life, and these two submarine Sailors had their moment captured on film.

Lone Wolf's Adam Costa, an assistant producer and self-described "logistics ninja," described one of the moments that made his time with the ship especially memorable:

"For me, one of those moments was the first time we saw the USS *Florida* on the day of our embark. It was an overcast day and the fog hung low and thick over Souda Bay. I was standing on the bow of a small tugboat with the rest of the film crew, the wind in our faces and the harbor to our backs. After a few minutes, we saw the outline of the *Florida*'s sail, just a dark spot in the fog where a moment before there had been only uninterrupted gray. The true shape quickly materialized, changing from a shadowy apparition to a real ship," said Costa. "It was like something out of a movie — just incredible."

The episode of National Geographic's "Naked Science" featuring *Florida* aired in June.

Being the focus of attention is not a new sensation for *Florida* Sailors. *Florida* was the centerpiece of operation Giant Shadow, the Navy's first test of the SSGN concept. Now the public has a chance to see this pioneering ship and her dedicated Sailors both on the big and the small screen.

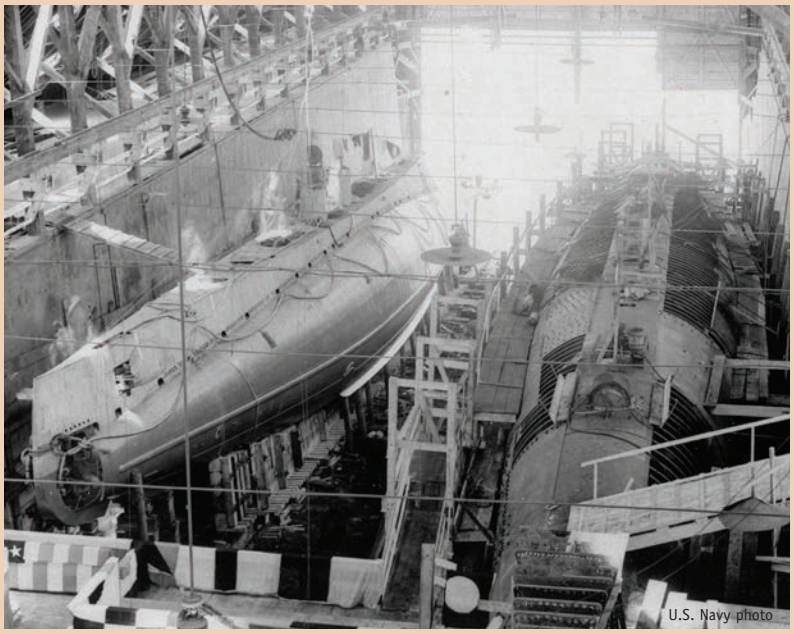
Petty Officer 1st Class Kimberly Clifford is a mass communications specialist with Submarine Group TEN Public Affairs.

by John J. Patrick

How the Navy Learned to Build Submarines

When it came to submarines, America got in on the ground floor. By 1900, there were at least half a dozen major industrial powers, but only France surpassed the United States in developing undersea craft. Both countries had begun to produce operable submarines, but not surprisingly, they went about it in entirely different ways.

In France, government quickly took the lead. For two centuries, the French had tried and failed to match the naval power of Britain, their longstanding rival. Eventually, France's weaker navy settled on a strategy that took superior British sea power for granted. Avoiding pitched battles with the Royal Navy, it would ambush British warships blockading French ports and would send out commerce raiders to decimate the merchant shipping that was the lifeblood of the British Empire.



S-3, shown under construction at the Portsmouth Naval Shipyard in July 1918, was the first submarine designed by the U.S. Navy. The smaller boat undergoing repairs on the left is *O-1*, built earlier by Portsmouth to an Electric Boat design.

French naval authorities eagerly embraced any new technology that might help circumvent British sea power. Recognizing the submarine's potential for mounting surprise attacks on warships and merchant vessels, they not only acquired the new boats conceived by French inventors but also funded the inventors' work and even joined them in developing submarine technology.

In America, the private sector drove submarine development. The U.S. Navy was more interested in rivaling British naval supremacy than getting around it. Steeped in Alfred Thayer Mahan's theory of decisive fleet action and buoyed by America's growing industrial might, the Navy wanted a state-of-the-art battle fleet to rival any in the world. It doubted the usefulness of submarines, and its technical bureaus saw no reason to provide funds for their development, much less to become actively involved.

The naval bureaus' preoccupation with surface ships made them poor collaborators on submarine projects in any case. Recent success in building America's first steel fleet left them with preconceptions that crippled their ability to deal with undersea craft. America's leading submarine inventor, John Holland, learned this to his dismay when he attempted to fulfill a Navy contract to build the experimental submarine *Plunger* in 1895-97. Unrealistic specifications and insistence on inappropriate features like steam propulsion made it impossible to deliver a viable boat.

Far-sighted officers like Adm. George Dewey eventually prevailed upon the Navy to acquire a few boats built to Holland's own designs, beginning with the purchase of *Holland VI* (USS *Holland*) in 1900. However, the service showed little interest in gaining any technical knowledge beyond what was required to operate the new vessels. The expertise to develop, design and build them remained firmly in the private sector.

Holland and his great rival, Simon Lake, ran their submarine companies on a shoestring. Their principal assets were the patents they controlled and their expertise and experience. They had minimal facilities and little capital. In the yet-unstructured market for their product, they had to pursue every fleeting opportunity and wheel and deal to make sales. The fledgling submarine companies resembled many hi-tech startups a century later: knowledge-driven, lean, agile, highly entrepreneurial, undercapitalized, and often on the brink of financial ruin.

To build their boats, the companies contracted with whatever shipyard offered the best deal. At one point in the late 1890s,

Holland's ill-fated *Plunger* and Lake's first submarine, *Argonaut I*, were both under construction in the same graving dock at the Columbian Iron Works and Dry Dock Company, in Baltimore, Md. *Holland VI*, the first submarine commissioned by the Navy, was built at the Crescent Shipyard in Elizabethport, N.J., which later built improved Holland boats. Finding it difficult to compete with Holland for U.S. Navy orders, Lake had the Newport News Shipbuilding and Dry Dock Company build boats for shipment to Russia.

In 1899, Isaac Rice, a successful entrepreneur, absorbed Holland's original firm into the new Electric Boat Company. The new firm included the Electro-Dynamic Company, which produced electric motors and other electrical equipment, and the Electric Launch Company, an established builder of private yachts and other craft in Bayonne, N.J. This diversification helped make Electric Boat (EB) a bit less dependent on future submarine orders, particularly given the growing civilian market for Electro-Dynamic's products.

Electro-Dynamic provided the electrical installations for Holland boats, and Holland himself had built submarine engines. Thus from the outset, Electric Boat was heavily involved in propulsion, the most complex and expensive aspect of the new boats. Rice might perhaps have envisioned Electric Launch someday expanding into submarine construction, but Electric Boat opted instead to keep the submarine staff focused on their core competencies of development, design and technical oversight. Not for a quarter century would the company build a submarine in a yard of its own. Until then, its boats were built mostly at the Union Iron Works in San Francisco, Calif., or the Fore River Shipyard in Quincy, Mass.

At first, American submarines used readily available gasoline engines, but gasoline fumes could be dangerous and debilitating in the close quarters of a submerged boat. In 1904, the French navy introduced a submarine powered by the recently invented diesel engine, which used less volatile fuel. Electric Boat began making diesel engines in 1909 at the Fore River Shipyard, but it soon opened a dedicated diesel engine factory in Groton, Conn., run by a subsidiary called the New London Ship and Engine Company (NELSECO).

Avoiding the financial burden of a submarine yard proved wise. Although Electric Boat dominated the U.S. submarine market, business was scarce. The company built only 25 boats for the Navy prior to the World War I build-up. When orders lagged, EB's carefully nurtured political influence sometimes persuaded Congress to fund boats the Navy did not request.

Like Lake, Electric Boat also scrambled for foreign orders. It sold submarines to both Russia and Japan in the Russo-Japanese War and helped both countries establish their own submarine industries. The company licensed Vickers to build the first submarines for the Royal Navy, and Vickers in turn provided financing that saved EB from bankruptcy.

Simon Lake was so dependent on orders from overseas that he moved to Europe, where he built submarines for Russia and the Austro-Hungarian Empire. Finally, in 1908, he got his first U.S. Navy contract, followed by another in FY 09 and a third in FY 10. Returning to America, Lake decided to become a shipbuilder. Newport News built his first two U.S. Navy boats, but the third, *Turbot* (*G-3*, later *SS-31*), was laid down on Oct. 20, 1909, at the Lake Torpedo Boat Company's new shipyard in Bridgeport, Conn.

After establishing America's first dedicated submarine yard, Lake's company went bankrupt in November 1913. Fortunately, the Navy had placed three additional orders with his firm before it failed, and the arms race leading up to World War I promised even more, so Lake was able to get the company and its new yard back in business in a few months.

War broke out in Europe in August 1914. The United States would remain neutral until April 1917, but the U.S. fleet was already expanding. For the first time, funding for submarines became plentiful. The Navy acquired 131 new boats in the World War I era (*H* through *S* classes), including 92 designed by EB, 22 by Lake, and, eventually, 19 designed by the Navy itself.

Most of the business went to the usual shipyards. Fore River built 56 subs; San Francisco's Union Iron Works, 23. The Lake Torpedo Boat Company built 20 and subcontracted another five to builders in Los Angeles, Calif., with no prior submarine experience. Five EB boats went to novice submarine builders in Seattle, Wash. In an unusual move, the Navy acquired the components for six EB boats and assembled them at the Puget Sound Naval Shipyard (which also built one other boat to an EB design). The Portsmouth Naval Shipyard in Kittery, Me., built one boat designed by Lake, then one by EB, and, finally, 11 boats to a Navy design.

For the world's largest industrial base, 131 submarines was not impressive—even adding 40 that Electric Boat delivered to foreign countries. Britain's much smaller industrial base produced a comparable number of submarines (*E* through *R* classes, less 20 boats from EB). Germany turned out over 400.

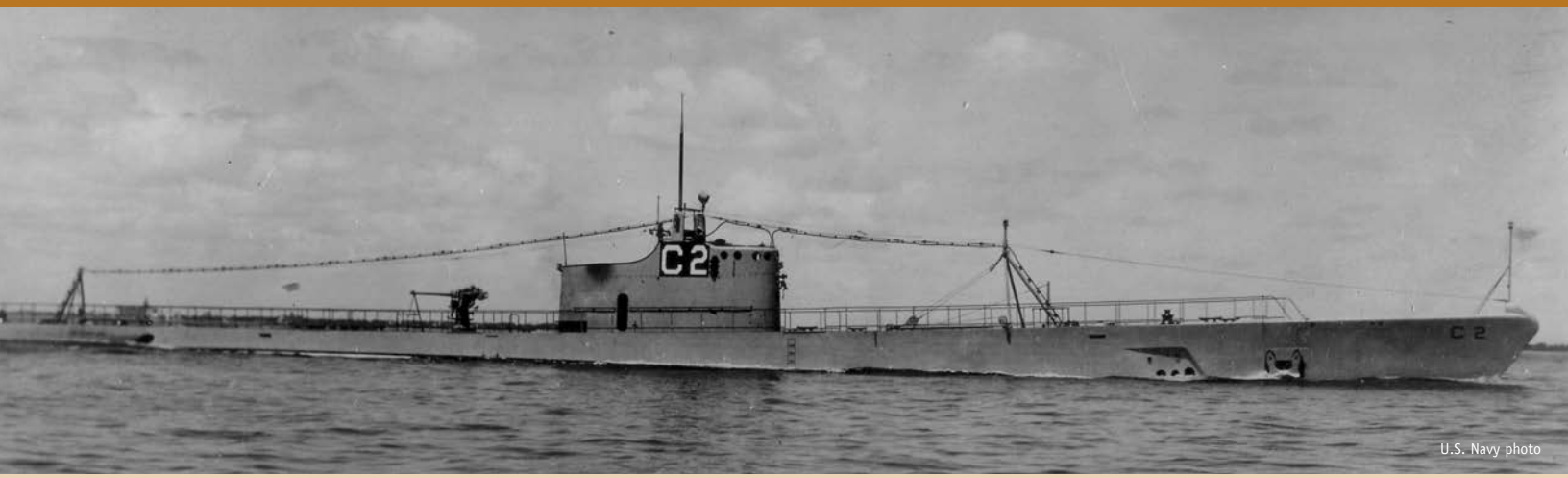
One reason for the modest building program was the lack of a compelling mission. The Allies' oceanic supply lines and massive naval operations gave German *U*-boats plenty to do. In contrast, the warships and remaining merchant ships of Germany and her allies seldom ventured out of protected waters. Some daring British submariners managed to do damage in restricted enemy waters like the Baltic Sea and the Dardanelles, and British submarines also interdicted German *U*-boats on their way to prey on Allied shipping, but the Royal Navy had plenty of submarines for these limited missions.

Thus, although funding for U.S. submarines increased notably after 1914 and dramatically after 1917, they never had top priority for materials and labor. In fact, the Navy seemed unable to set any consistent priority. In a November 1917 comment on construction delays, the General Board, which advised the Navy leadership on policy, asserted that submarines had a priority just below the destroyers desperately needed to escort convoys. Yet in the fall of 1918, Electric Boat protested that the government had informed one of its associated shipyards that even cargo ships had a higher priority.

U.S. industrial mobilization for World War I was generally inept and chaotic, and the Navy was in no position to coordinate submarine construction. Wartime scarcities and economic controls made it difficult even to administer previous contracts. After the Armistice, Electric Boat submitted more than $7 million in claims for additional compensation, almost half of which were accepted.

Only about 40 percent of the U.S. submarines built for World War I were in service when the Armistice ended the fighting on Nov. 11, 1918 (*H* through *O* classes plus a few of the *R*-class), and every one of those boats was already ordered before America entered the war. Fortunately, the delay had little military effect given U.S. submarines' marginal mission.

The inferior performance of the new boats was more daunting. In 1900, America was at the forefront of submarine technology. By 1917, it was far behind, mainly due to the Navy's unwillingness to get involved. The



U.S. Navy photo

Cuttlefish (SS-171), shown with her bow planes rigged out prior to diving during 1934 builder's trials off Connecticut, was the first submarine that Electric Boat built to what was essentially a Navy design.

war laid bare the disadvantages of leaving the development, design and construction of warships to the private sector.

The Navy issued broad requirements for each class, and the submarine firms offered whatever they saw fit. Because the Navy did not have the knowledge to collaborate, the relationship was purely contractual, with the companies eager to build up their previously fragile financial position as much as possible. This led to distrust and resentment on both sides.

Viewed from the 21st Century, the latitude American submarine companies had in the World War I era seems almost comical. As late as 1911, Simon Lake insisted on delivering USS *Seal*, his first U.S. order, with wheels for running along the bottom. If both firms got orders for the same submarine class, each produced a different boat. The seven Lake boats in the "*R*" class, all commissioned in 1919, still had obsolete amidships diving planes. Electric Boat held patents that it refused to license to Lake, and vice versa. Lake's prototype for the *S*-class had the best surface performance, but its submerged performance was unsatisfactory due in part to the need to avoid infringing EB patents.

Sometimes, the companies just ignored Navy requirements. In March 1915, the Navy asked each firm for one submarine to cost no more than $1.5 million (a handsome sum with gold at $20 per ounce) and do 20 knots on the surface. Lake proposed two alternatives, both more expensive, and refused to commit to more than 18 knots. Electric Boat agreed to meet the Navy price, but only if it got both boats plus unusually lax terms for delivery.

The Navy wound up giving EB both boats and accepting 19 knots in return for more timely delivery. This was not entirely unreasonable, since the Navy had neither the construction knowledge to justify its cost cap nor the design expertise to determine how much achieving 20 knots would degrade other critical characteristics.

The submarine companies' insistence on controlling development, design and production was an understandable reaction to Navy neglect, which had kept them on the brink of failure for over a decade. But their fixation on their own interests and preferences instead of Navy goals seemed intolerably highhanded to the growing U.S. Submarine Force. American officers began to appreciate the Royal Navy's centralized direction of submarine development, its effective control of patents, its systematic testing of prototypes to optimize design, and its ability to impose standardization regardless of contractor.

The Navy took the first steps toward rationalizing development and procurement in 1916, with the *S* class. For the first time, it ordered competing prototypes: *S-1* from EB, *S-2* from Lake, and *S-3*, from the Portsmouth Naval Shipyard. Equally important, *S-3* was entirely a Navy design, co-developed by the Bureau of Engineering (which dealt with machinery) and the Bureau of Construction and Repair (which dealt with ships).

The Navy put both the *S-1* and *S-3* designs into production but rejected Lake's *S-2* (later compensating Lake with orders for eight *S-3* follow-ons). Once again, the Navy sacrificed standardization within a class, but this time with the specific intent of learning the submarine business. Designing and building *S-3* plus ten follow-on boats gave Portsmouth a design team and construction know-how rivaling those in the private sector.

Meanwhile, evaluation of captured German *U*-boats starting in 1918 showed how far behind America had fallen. The *U*-boats were superior in every respect except habitability, including sea-keeping, submerged performance, and overall ruggedness and reliability. Their diesel engines were outstanding — far less likely to break down than EB's NELSECO engines, less prone to oil leaks and smoking than the more reliable engines the Bush-Sulzer Company produced for Lake, and over 10 percent more powerful for their weight than any American engine.

Germany's huge submarine program had enabled German industry to fund the research and development needed to overcome the problem of torsional vibration in high-performance diesels. In contrast, American industry did not yet understand what caused the destructive vibration. Moreover, American metallurgy could not produce reliable engine castings thin enough to match German performance.

Rather than accept the daunting challenge of building diesels powerful enough for the first "*V*-class" design — three large, 20+–knot boats funded in 1919 — Bush Sulzer dropped out of the submarine business altogether. Electric Boat was willing to provide the engines but lacked credibility with the Navy, having repeatedly denied Navy claims that the design of its current engines was flawed and adamantly rejected Navy demands to fix them at its own expense.

Completing the *S* class kept the submarine firms going into the 1920s, but the Navy's assignment of all subsequent construction to Portsmouth left the private sector with no new orders until 1931. The Lake Torpedo Boat Company folded for good in 1924. Electric Boat scrambled for business. Ironically, the Navy helped keep EB solvent by paying for it to rebuild NELSECO diesels

in *S*-class boats starting in 1922.

For this work, Electric Boat established basic shipyard facilities at its Groton plant, the first time it performed any submarine work in a yard of its own. The new yard also began to repair and build small ships for private owners. In 1924, EB received the first of four submarine orders from Peru. Building these boats — the first EB had ever constructed — required further yard facilities. In 1929, corporate management abolished the NELSECO subsidiary and took direct control of both the shipyard and the factory under the EB name.

Meanwhile, Navy involvement in submarine development, design and construction rapidly increased. Only seven new submarines were laid down through 1930. Portsmouth designed them all and built all but one. The exception was *Nautilus* (SS-168), laid down in 1927 at California's Mare Island Naval Shipyard, slated to become the leading West Coast submarine yard. The seven boats were technically units of the *V* class, but they were not recognizable as such. Built to four different designs, they were more or less experimental prototypes — not very successful, but useful for working out requirements and testing technology.

The Bureau of Engineering tackled the diesel problem, establishing its own relationship with German diesel manufacturer Machinenfabrik Augsburg-Nürnberg (MAN) and developing versions of MAN designs at the New York Naval Shipyard. However, improvement remained slow. Eventually, emerging demand for diesel railroad locomotives in the 1930s stimulated General Motors and Fairbanks Morse to complete the development of truly reliable engines.

Meanwhile, the bureau explored using diesel-electric drive to avoid the RPM ranges where destructive vibration occurred. By using the engines only to generate electricity, which in turn powers electric motors on the propeller shafts, diesel-electric drive eliminates any mechanical coupling between the diesels and the shafts, allowing the engines to operate constantly in their most efficient RPM range. Diesel-electric drive would become standard for U.S. submarines of World War II.

Intimate Navy involvement with submarine technologies ranging from hull design and propulsion to periscopes and torpedo data computers began to bear fruit with the fifth and last *V*-class design. The resulting submarines, *Cachalot* (SS-170) and *Cuttlefish* (SS-171), were too small to be successful, but they laid the groundwork for the fleet boats that would contribute so much to winning the coming war in the Pacific.

Electric Boat got the *Cuttlefish* order, the first contract awarded a private firm since 1918. The company had somehow retained a strong design capability despite the long drought. Responsible for detailed arrangement, it improved significantly on Portsmouth's layout. *Cuttlefish* was also the first submarine with air conditioning. EB introduced a major construction innovation, the use of welding in the pressure hull, as opposed to the all-riveted construction Portsmouth still favored. Welded construction soon became standard.

Electric Boat's performance vividly demonstrated the continued importance of private initiative in submarine building. Moreover, the Navy had learned from its experience at Portsmouth how much effort it took to keep a submarine-building organization performing well in demanding circumstances. Bitter memories from the purely legalistic framework of the World War I era were slow to fade, but the old adversarial relationship gradually yielded to better understanding and appreciation on both sides.

The key difference was the Navy's expertise in developing, designing and building submarines. The service was now prepared to act not just as a partner, but as the senior partner, providing the consistent working-level direction and coordination so lacking in World War I. Its ability to nurture and lead a powerful government-industry team would ensure the success of American submarine construction in World War II. The Navy at last knew how to build submarines.

Mr. Patrick is senior editor of UNDERSEA WARFARE Magazine.

Interested in Learing More?

Anyone interested in learning more about American submarine-building before World War II should read the main source for this article: Gary E. Weir's excellent book *Building American Submarines: 1914-1940*. Other sources are *The Legend of Electric Boat*, an authorized company history by Jeffrey L. Rodengen; two UNDERSEA WARFARE articles by Edward C. Whitman—"The Submarine Heritage of Simon Lake" (fall 2002) and "The Navy's Variegated V Class" (fall 2003); and Wikipedia's detailed chronology of U.S. submarine classes. (Note that these sources may disagree with the current article's conclusions and opinions, which are the author's.) Also recommended is one of the sources for the Whitman articles: Norman Friedman's *U.S. Submarines through 1945: an Illustrated Design History*.

First Women Selected for Submarines

by Director, Submarine Warfare (N87), Public Affairs

The policy change to allow women to serve in submarines cleared the last hurdle on April 29, 2010, enabling the Navy to select the first female candidates for submarine officer training.

Secretary of Defense Robert Gates officially notified congressional leaders of the policy change in a letter dated Feb. 19, 2010. Before the change could take effect, the law required that both houses of Congress be in session for 30 days in order to have time to consider it. When that period expired without congressional action, Rear Adm. Barry Bruner, Commander of Submarine Group TEN and leader of the Women in Submarines Task Force, formally announced the new policy on April 29.

Photo by Petty Officer 3rd Class Ash Severe

The first women assigned to submarines will be officers. They will serve in SSGNs and SSBNs, which have appropriate berthing and facilities to accommodate them.

"There are extremely capable women in the Navy who have the talent and desire to succeed in the Submarine Force," said Secretary of the Navy Ray Mabus. "Enabling them to serve in the submarine community is best for the Submarine Force and our Navy. We literally could not run the Navy without women today."

Currently, women make up 15 percent of the active-duty Navy, 52,446 of the 330,700 total. Integrating women into the Submarine Force will increase the talent pool and thus help ensure the future readiness of the Silent Service.

"The young women that have come up to me since we announced our intention to change the policy have such great enthusiasm," said Adm. Gary Roughead, Chief of Naval Operations. "Knowing the great young women we have serving in the Navy, as a former commanding officer of a ship that had a mixed-gender crew, to me it would be foolish to not take the great talent, the great confidence and intellect of the young women who serve in our Navy today and bring that into our Submarine Force."

To avoid delay, the Submarine Force will begin by assigning female officers to crews of guided-missile attack submarines (SSGNs) and strategic ballistic missile submarines (SSBNs), which have appropriate officer berthing and facilities to accommodate the first women without time-consuming modifications. The assignments will involve the Blue and Gold crews of two submarines on the East Coast and two on the West Coast, for a total of eight crews.

In May, the Submarine Force and the Director, Naval Reactors, selected 19 female midshipmen who were about to receive their commissions — 11 from the U.S. Naval Academy and eight from Naval Reserve Officer Training Corps (NROTC) units. The new ensigns will first complete the 15-month submarine officer training pipeline, which consists of nuclear power school, prototype training, and the Submarine Officer Basic Course.

New Award for Acquisition Excellence

Photo by Olivia Logan

The Naval Submarine League has established a new award for excellence in submarine acquisition in honor of the late Vice Adm. J. Guy Reynolds. Jan Reynolds, the admiral's wife, presented the first Vice Adm. J. Guy Reynolds Award to Capt. Michael E. Jabaley, Jr., the *Virginia*-class program manager for PEO Submarines. The presentation took place at a Sept. 21 Fleet Awards Luncheon during the Sub League's 2010 Symposium in Tysons Corner, Va. Pictured, from left to right, are Sub League Board Chairman retired Adm. Rich Mies; Capt. Jabaley; Jan Reynolds; Commander, Submarine Forces, Vice Adm. Jay Donnelly; and Sub League President retired Rear Adm. John B. Padgett.

Changes of Command

Program Executive Office for Submarines
Rear Adm. David C. Johnson relieved
Rear Adm. William H. Hilarides

COMSUBDEVRON 5
Capt. Brian Howes relieved
Capt. Stuart Munsch

COMSUBRON 7
Capt. James E. Pitts relieved
Capt. Christopher Kaiser

COMSUBRON 11
Capt. Richard Correll relieved
Capt. Brett Genoble

COMSUBRON 15
Capt. John K. Russ relieved
Capt. Douglas E. Wright

COMSUBRON 17
Capt. Paul A. Skarpness relieved
Capt. David S. Ratte

COMSUBRON 19
Capt. Dennis E. Carpenter relieved
Capt. John W. Tammen

USS New Mexico (SSN-779)
Cmdr. George Perez relieved
Cmdr. Mark Prokopius

USS Maine (SSBN-741) (G)
Cmdr. Richard Massie relieved
Capt. William Breitfelder

USS Henry M. Jackson (SSBN-730) (B)
Cmdr. Eugene Nemeth relieved
Cmdr. Lyle Hoag

USS Chicago (SSN-721)
Cmdr. Nicholas R. Tillbrook relieved
Capt. James E. Horten

USS Nevada (Crew Split)
Cmdr. Peter Hudson assumed command of Gold
Cmdr. Edward Schrader assumed command of Blue

USS Hampton (SSN-767)
Cmdr. David Lott relieved
Cmdr. William Housten

USS Albuquerque (SSN-706)
Cmdr. Chris Cavanaugh relieved
Cmdr. Michael Badorf

USS Columbia (SSN-771)
Cmdr. Dennis Klein relieved
Cmdr. Craig Blakely

USS Bremerton (SSN-698)
Cmdr. Caleb Kerr relieved
Cmdr. Howard Werner III

USS Topeka (SSN-754)
Cmdr. Mike Bratton relieved
Cmdr. Mark Stern

USS Charlotte (SSN-766)
Cmdr. Scott Young relieved
Cmdr. Butch Dollaga

USS Buffalo (SSN-715)
Cmdr. Richard E. Seif relieved
Cmdr. Michael D. Lewis

USS Maine (SSBN-741) (G)
Cmdr. Rich Massie relieved
Capt. William Breitfelder

USS Alaska (SSBN-732) (B)
Cmdr. Kevin Byrne relieved
Cmdr. Paul Haebler

USS Georgia (SSGN-729) (B)
Capt. J. Kelly McDowell relieved
Capt. Brian McIlvaine

Qualified for Command

Lt. Cmdr. Lauren Allen
COMSUBRON ONE

Lt. Cmdr. John Armstrong
USS Pasadena (SSN-752)

Lt. Cmdr. Brian Earp
COMSUBRON THREE

Lt. Cmdr. William Filip
COMSUBRON ELEVEN

Lt. Cmdr. Stanley Freemyers
USS Philadelphia (SSN-690)

Lt. Cmdr. James Gillison
USS Wyoming (SSBN-742) (B)

Lt. Cmdr. Anthony Harrell
COMSUBRON TWENTY

Lt. Cmdr. Quinton L. James
USS Wyoming (SSBN-742) (G)

Lt. Cmdr. John Killila
USS Maine (SSBN-741) (B)

Lt. Cmdr. Micah Maxwell
COMSUBRON ONE

Lt. Cmdr. Brian Mcguirk
COMSUBRON SEVENTEEN

Lt. Cmdr. Terry Nemec
USS Ohio (SSGN-726) (B)

Lt. Cmdr. David Payne
USS Alexandria (SSN-757)

Lt. Cmdr. Joshua Powers
USS Ohio (SSGN-726) (B)

Lt. Cmdr. James Prouty Jr.
COMSUBRON FIFTEEN

Lt. Cmdr Steven W. Roberts
COMSUBRON SIXTEEN

Lt. Cmdr. Chad Roum
USS Louisville (SSN-724)

Lt. Cmdr. Eric Rozek
USS Pittsburgh (SSN-720)

Lt. Cmdr. Joseph Rysavy
USS Los Angeles (SSN-688)

Lt. Cmdr. Richard Salazar
USS San Juan (SSN-751)

Lt. Cmdr. Brent Spillner
COMSUBRON ELEVEN

Lt. Cmdr. William B. Swanbeck
OPNAV N87

Lt. Cmdr. Brandon E. Todd
USS Springfield (SSN-761)

Lt. Cmdr. John Witte
USS Michigan (SSGN-727) (G)

Lt. Michael Dolbec
USS San Juan (SSN-751)

Lt. Michael Seguin
USS San Juan (SSN-751)

Lt. Thomas Weiler
USS Charlotte (SSN-766)

Qualified Nuclear Engineer Officer

Lt. Raymond Ahaus
USS Key West (SSN-722)

Lt. Michael Billings
USS Houston (SSN-713)

SSGN Force Reaches Historic Milestone

by Petty Officer 2nd Class Gretchen Albrecht, Submarine Group NINE Public Affairs

USS *Florida* (SSGN-728) at Diego Garcia in June, following a remote crew exchange and the first voyage repair period of her second deployment.

On June 10, 2010, the Submarine Force achieved another first, with all four guided missile submarines (SSGNs) deployed for the first time simultaneously. Although West Coast SSGNs USS *Ohio* (SSGN-726) and USS *Michigan* (SSGN-727) and East Coast SSGNs USS *Florida* (SSGN-728) and USS *Georgia* (SSGN-729) had previously been underway at the same time, this marked the first time all four were forward-deployed away from their homeports.

The submarines deploy for approximately 12 months, with some deployments lasting up to 15 months. While the SSGNs are away from their homeports, bases in Diego Garcia and Guam provide ideal locations for crew exchanges and voyage repair periods. Maintenance periods and crew exchanges occur approximately every three months and allow the SSGNs to maintain a continuous presence in the areas of operation for 70 percent of the year.

Between them, the four SSGNs had already completed a total of seven successful deployments as of June and a combined 1,995 days underway.

Lt. Taylor Bond
USS Henry M. Jackson (SSBN-730) (B)

Lt. Ryan Bush
USS Cheyenne (SSN-773)

Lt. Jonathan Cebik
USS Pasadena (SSN-752)

Lt. Paul Creedon
USS Jimmy Carter (SSN-23)

Lt. Jay Davis
USS Houston (SSN-713)

Lt. Michael Fritts
USS Louisville (SSN-724)

Lt. Thomas Johnson
USS Cheyenne (SSN-773)

Lt. Edward May, Jr.
USS Miami (SSN-755)

Lt. Gregory Mccarthy
USS Olympia (SSN-717)

Lt. Joshua Mueller
USS Pasadena (SSN-752)

Lt. Richard Pell
USS Pennsylvania (SSBN-735) (B)

Lt. Timothy Perkins
USS City of Corpus Christi (SSN-705)

Lt. Brandon Rathke
USS Henry M. Jackson (SSBN-730) (G)

Lt. William Stange
USS Seawolf (SSN-21)

Lt. Justin Stepanchick
USS Ohio (SSGN-726) (B)

Lt. Alexander Tafreshi
USS Jimmy Carter (SSN-23)

Lt. Keith Turnbull
USS Virginia (SSN-774)

Lt. Christopher Turner
USS Olympia (SSN-717)

Lt. Andrew Warner
USS Nebraska (SSBN-739) (G)

Lt. Joshua Weiss
USS Nevada (SSBN-733) (B)

Lt. Matthew Yanoff
USS Connecticut (SSN-22)

Lt. j.g. David Adams
USS Nebraska (SSBN-739) (B)

Lt. j.g. Gary Adams
USS Greeneville (SSN-772)

Lt. j.g. Maksudul Ali
USS San Francisco (SSN-711)

Lt. j.g. Daniel Ayala
USS Greeneville (SSN-772)

Lt. j.g. Bradley Blanchette
USS Connecticut (SSN-22)

Lt. j.g. Brian Boeckmann
USS Cheyenne (SSN- 773)

Lt. j.g. Matthew Braden
USS Alabama (SSBN-731) (B)

Lt. j.g. Donald Breazeale
USS Helena (SSN-725)

Lt. j.g. Mark Burchill
USS Alabama (SSBN-731) (G)

Lt. j.g. Patrick Brooks
USS Ohio (SSGN-726) (G)

Lt. j.g. Brett Byrnes
USS Hawaii (SSN-776)

Lt. j.g. Joseph Campbell
USS Pennsylvania (SSBN-735) (G)

Lt. j.g. John Carter
USS Kentucky (SSBN-737) (B)

Lt. j.g. Peter Chivers
USS Louisiana (SSBN-743) (B)

Lt. j.g. Matthew Christensen
USS Ohio (SSGN-726) (B)

Lt. j.g. James Clough
USS Henry M. Jackson (SSBN-730) (G)

Lt. j.g. Christopher Corey
USS La Jolla (SSN-701)

Lt. j.g. Gregory Coy
USS Bremerton (SSN-698)

Lt. j.g. John Donovan
USS Pennsylvania (SSBN-735) (G)

Lt. j.g. Thomas Dunbar
USS Buffalo (SSN-715)

Lt. j.g. Derek Ferguson
USS Nevada (SSBN-733) (B)

Lt. j.g. Andrew Freeman
USS Michigan (SSBN-727) (B)

Lt. j.g. Peiffer Garrick
USS Louisiana (SSBN-743) (B)

Lt. j.g. Ekon George
USS Jimmy Carter (SSN-23)

Lt. j.g. Donald Harrington
USS Greeneville (SSN-772)

Lt. j.g. Arturo Jancito
USS Texas (SSN-775)

Lt. j.g. Benjamin Jones
USS Henry M. Jackson (SSBN-730) (B)

Lt. j.g. Cal Kimes
USS Los Angeles (SSN-688)

Lt. j.g. David Koeppel
USS Alabama (SSBN-731) (B)

Lt. j.g. Bryan Kreller
USS Topeka (SSN-754)

Lt. j.g. Simon Lee
USS Hampton (SSN-767)

An Arleigh Burke Trophy for *West Virginia*'s Gold Crew

On July 20, 2010, the Navy awarded the Atlantic Arleigh Burke Fleet Trophy for 2009 to the Gold Crew of USS *West Virginia* (SSBN-736)—the first SSBN crew to receive the prestigious award since 1985, when it went to the Gold crew of USS *Casimir Pulaski* (SSBN-633).

The Arleigh Burke Trophy is presented annually to the ship crew or aviation squadron—one in the Atlantic and one in the Pacific—that achieved the greatest improvement during the preceding year in operational readiness, inspections, retention and the Battle Efficiency Award program.

West Virginia's phenomenal year included the 2009 Submarine Squadron 20 Strategic White "S" and Engineering Red "E"; being evaluated "above standards" in a tactical readiness evaluation by Commander, Submarine Forces; and receiving the 2009 Commander, Fleet Force Command, Retention Excellence Award.

Lt. j.g. David Legault
USS Michigan (SSBN-727) (G)

Lt. j.g. Jonathan Lim
USS Santa Fe (SSN-763)

Lt. j.g. Nicholas Manzini
USS Charlotte (SSN-766)

Lt. j.g. Adam Mills
USS Key West (SSN-722)

Lt. j.g. Jacob Murray
USS Pennsylvania (SSBN-735) (G)

Lt. j.g. Damian Oslebo
USS Nevada (SSBN-733) (B)

Lt. j.g. Benjamin Parks
USS Bremerton (SSN-698)

Lt. j.g. Brian Pennington
USS Jimmy Carter (SSN-23)

Lt. j.g. Beau Portillo
USS Maine (SSBN-741) (B)

Lt. j.g. Andrew Potts
USS Tucson (SSN-770)

Lt. j.g. Brent Powers
USS Houston (SSN-713)

Lt. j.g. Andrew Ra
USS Chicago (SSN-721)

Lt. j.g. Ryan Reed
USS Helena (SSN-725)

Lt. j.g. David Rickenbach
USS Henry M. Jackson (SSBN-730) (B)

Lt. j.g. Benjamin Sacramento
USS Nevada (SSBN-733) (B)

Lt. j.g. Andrew Sample
USS Pasadena (SSN-752)

Lt. j.g. Jeffrey Scheidt
USS Nebraska (SSBN-739) (B)

Lt. j.g. William Schindele
USS Key West (SSN-722)

Lt. j.g. Alan Teele
USS Topeka (SSN-754)

Lt. j.g. Chad Tella
USS Santa Fe (SSN-763)

Lt. j.g. Joshua Turner
USS Michigan (SSBN-727) (G)

Lt. j.g. Robert Twitchell
USS Columbus (SSN-762)

Lt. j.g. Stephen Ulrich
USS City of Corpus Christi (SSN-705)

Lt. j.g. Thomas Williams
USS Topeka (SSN-754)

Lt. j.g. Caleb Wines
USS Texas (SSN-775)

Lt. j.g. Daniel Yeaw
USS Greeneville (SSN-772)

Line Officer Qualified in Submarines

Lt. Christopher Oleary
USS Louisville (SSN-724)

Lt. j.g. Benjamin Abeto
USS Tucson (SSN-770)

Lt. j.g. David Adams
USS Nebraska (SSBN-739) (B)

A Busy Summer for USS *Hawaii*

by Olivia Logan

(Left) Crewman Petty Officer 1st Class Allan Kleaving explains basic submarine operations to Miss Hawaii 2010. *(Right) Hawaii* arrives at Yokosuka.

USS *Hawaii* (SSN-776) had a busy summer hosting notable visitors and achieving a new milestone for the *Virginia* class. In late July, she welcomed her sponsor, Hawaii Governor Linda Lingle, for a day at sea. Gov. Lingle witnessed operational demonstrations and interacted with the crew, including presenting Petty Officer 3rd Class Cody Wyrick with his submarine warfare qualification pin.

In mid-August, *Hawaii* hosted Jalee Kate Fuselier, the recently crowned 2010 Miss Hawaii, at Joint Base Pearl Harbor-Hickam. Ms. Fuselier toured the boat, dined with the crew, and posed for photos with Sailors.

In September, it was *Hawaii*'s turn to be the visitor, becoming the first *Virginia*-class submarine to visit the Western Pacific. She arrived at Yokosuka Naval Station, Japan, Sept. 3, on her first deployment from her current homeport at Pearl Harbor.

"My crew has worked very hard to train in preparation for this important deployment," said Cmdr. Steve Mack, *Hawaii*'s commanding officer. "I'm proud that my submarine is the first of its class to ever deploy to the Western Pacific region, and I'm looking forward to completing all assigned tasking over the next few months."

First Major Maintenance for *Virginia* Class

Submarine Group TWO Commander Rear Admiral McGlaughlin and Submarine Group TWO Shipyard Representative Capt. Michael Martin (left) walk off the brow upon *Virginia*'s arrival at PNSY.

USS *Virginia* (SSN-774) arrived at Portsmouth Naval Shipyard (PNSY) Sept. 1 for the first major maintenance availability of its class. *Virginia*'s Extended Dry-docking Selected Restricted Availability (EDSRA) will involve a variety of maintenance work and several system upgrades.

Nearly three years prior to *Virginia*'s arrival, the shipyard assembled a *Virginia*-class planning team comprising personnel from the engineering and production departments. The team developed the detailed workload strategy and execution plans and identified the required resources and skill to ensure PNSY was ready to execute on day one.

"We've been working towards this day for years, and we are ready to execute," said Deputy Project Superintendent Cmdr. Gus Vergara. "The Submarine Force is looking to us to deliver on time and at or below cost."

Photo by Petty Officer 3rd Class Adam Thomas

Tucson in Exercise Invincible Spirit

USS *Tucson* (SSN-770) led the photo formation for Exercise Invincible Spirit, which took place east of the Korean peninsula in late July 2010. A combined alliance maritime and air readiness exercise involving numerous units from the Republic of Korea and the United States, Invincible Spirit was the first in a series of joint military exercises that took place in response to North Korea's March 26 sinking of the Republic of Korea Navy corvette *Cheonan*.

Lt. j.g. Derek J. Anastasiades
USS Philadelphia (SSN-690)

Lt. j.g. Daniel Ayala
USS Greeneville (SSN-772)

Lt. j.g. Gregory Barnekoff
USS La Jolla (SSN-701)

Lt. j.g. David Camp
USS Louisville (SSN-724)

Lt. j.g. Eric O. Cates
USS Wyoming (SSBN-742) (G)

Lt. j.g. Benjamin Cavin
USS Nebraska (SSBN-739) (B)

Lt. j.g. John Coleman
USS Olympia (SSN-717)

Lt. j.g. Dennis Crump
USS Toledo (SSN-769)

Lt. j.g. Peter Daderko
USS Maine (SSBN-741) (G)

Lt. j.g. Christopher Dibble
USS Kentucky (SSBN-737) (B)

Lt. j.g. Craig Dobson
USS Asheville (SSN-758)

Lt. j.g. Samuel C. Fleegle
USS Rhode Island (SSBN-740) (G)

Lt. j.g. Ekon George
USS Jimmy Carter (SSN-23)

Lt. j.g. Alexander Hagness
USS Olympia (SSN-717)

Lt. j.g. Christopher Hammonds
USS Key West (SSN-722)

Lt. j.g. Ryan Haskins
USS Maine (SSBN-741) (G)

Lt. j.g. Ryan Hilger
USS Maine (SSBN-741) (G)

Lt. j.g. Randall Jagoe
USS Texas (SSN-775)

Lt. j.g. Clifford Jessop
USS Texas (SSN-775)

Lt. j.g. Kyle Johnson
USS Maine (SSBN-741) (G)

Lt. j.g. Robert Johnson
USS Olympia (SSN-717)

Lt. j.g. Ryan Kelley
USS Buffalo (SSN-715)

Lt. j.g. Joshua Lail
USS Chicago (SSN-721)

Lt. j.g. Erick Lardizabal
USS Nebraska (SSBN-739) (B)

Lt. j.g. Cameron Lindsay
USS Texas (SSN-775)

Lt. j.g. Joshua Lister
USS Hartford (SSN-768)

Lt. j.g. Joshua Ludwig
USS Hawaii (SSN-776)

Lt. j.g. Robert P. Mayer
USS Alaska (SSBN-732) (G)

Lt. j.g. Doug Mcintosh
USS New Hampshire (SSN-778)

Lt. j.g. Daniel J. Miller
USS Rhode Island (SSBN-740) (G)

Lt. j.g. Tristan Monroe
USS Texas (SSN-775)

Lt. j.g. Kevin S. Mears
USS Alaska (SSBN-732) (G)

Lt. j.g. Jason Paradis
USS Key West (SSN-722)

Lt. j.g. Michael T. Pierce
USS Alaska (SSBN-732) (G)

Lt. j.g. James Rapuzzi
USS La Jolla (SSN-701)

Lt. j.g. Andrew Regalado
USS Greeneville (SSN-772)

Lt. j.g. Jeffrey Rosser
USS Tucson (SSN-770)

Lt. j.g. Jeffrey Scheidt
USS Nebraska (SSBN-739) (B)

Lt. j.g. Jeremiah Shumway
USS Maine (SSBN-741) (G)

Lt. j.g. Elijah M. Schussler
USS Dallas (SSN-700)

Lt. j.g. Reid W. Smythe
USS Florida (SSGN-28) (B)

Lt. j.g. Elliot Snell
USS Topeka (SSN-754)

Lt. j.g. Andrew Streenan
USS Topeka (SSN-754)

Lt. j.g. Scott Tedrick
USS Louisville (SSN-724)

Lt. j.g. Daniel Yeaw
USS Greeneville (SSN-772)

Limited Duty Officer Qualified in Submarines

Lt. Brian Nuss
USS Jimmy Carter (SSN-23)

Ensign Charles Lynn
USS Hampton (SSN-767)

Ensign Tyrone Richardson
USS Jimmy Carter (SSN-23)

Medical Officer Qualified in Submarines

Lt. Cmdr. Michael Arnold
COMSUBRON FIFTEEN

Lt. Derek Lodico
NSSC Pearl Harbor

Supply Officer Qualified in Submarines

Lt. Joshua R. Harding
USS Rhode Island (SSBN-740) (G)

Lt. j.g. Bert Bratton Jr.
USS Buffalo (SSN-715)

Lt. j.g. Paul Chapman
USS Chicago (SSN-721)

Lt. j.g. Tucker Taylor
USS Topeka (SSN-754)

Lt. j.g. Tucker Mckenney
USS Charlotte (SSN-766)

Maryland Skipper Receives Stockdale Leadership Award

Photo by Chief Petty Officer Tiffini Jones Vanderwyst

On Nov. 3, 2010, Chief of Naval Operations Adm. Gary Roughead presented the Vice Adm. James B. Stockdale Leadership Award to Cmdr. Jeffrey M. Grimes (right), representing U.S. Fleet Forces Command, and Cmdr. Michael A. McCartney (middle), representing U.S. Pacific Fleet.

The annual award recognizes two active-duty commanding officers below the rank of captain for leadership, personal initiative, exemplary performance and contribution to the overall success of the operational units they command. The two awardees, nominated by their peers, were among nine candidates recommended by their fleet commanders for consideration by a panel of senior officers.

Grimes assumed command of the Kings Bay, Ga.-based USS *Maryland* (SSBN-738) Gold crew in 2007. During his tour, *Maryland* received the 2008 and 2009 Commander, Submarine Squadron 20 "E" for battle efficiency and U.S. Strategic Command's 2008 Omaha Trophy for top performance among Trident submarines. These awards were among the many reasons Grimes was chosen to mentor prospective commanding and executive officers as part of the Strategic Program's Prospective Commanding Officer/Executive Officer Course.

"To get this award is very humbling," said Grimes. "This is a great honor to my family, it's a great honor to the ship and a great honor to those people that came before me who taught me, trained me and mentored me."

The Smoking Lamp Is Out for Good

by Commander, Submarine Forces Public Affairs

A policy change announced in an Apr. 8, 2010 message from Commander, Submarine Forces, (COMSUBFOR) banned smoking below decks onboard all U.S. Navy submarines effective no later than Dec. 31, 2010. The reason for the ban is the health risks to non-smokers, specifically, exposure to secondhand smoke.

"Our Sailors are our most important asset to accomplishing our missions," said then-COMSUBFOR Vice Adm. John J. Donnelly. "Recent testing has proven that, despite our atmosphere purification technology, there are unacceptable levels of secondhand smoke in the atmosphere of a submerged submarine. The only way to eliminate risk to our non-smoking Sailors is to stop smoking aboard our submarines."

According to a 2006 Surgeon General's report on involuntary exposure to tobacco smoke, there is no risk-free level of exposure to secondhand smoke. Non-smokers who are exposed to secondhand smoke increase their risk of developing heart and lung disease.

Subsequent to the 2006 Surgeon General report, COMSUBFOR chartered the Naval Submarine Medical Research Laboratory in Groton, Conn., to conduct a study on U.S. submarines. The study indicated that non-smoking Sailors were exposed to measurable levels of environment tobacco smoke (ETS), the technical name for secondhand smoke. The year-long study was conducted in 2009 on nine different submarines, including at least one from each class of submarines in the force.

"While submarine duty is a dynamic and demanding job, the Submarine Force is dedicated to mitigating unnecessary risks to our Sailors," Donnelly noted. "Exposure to a harmful substance that is avoidable, such as secondhand smoke, is unfair to those who choose not to smoke."

In conjunction with the policy change, cessation assistance to Sailors is being offered. The program incorporates education techniques and nicotine replacement therapy such as nicotine patches and nicotine gum to assist in kicking the smoking habit. In keeping with current submarine policy, drugs such as Zyban™ and Chantix™ are not authorized.

"To help smokers minimize the effects of quitting, nicotine replacement therapy such as patches and gum will be readily available, along with an extensive cessation training and support program on every boat," said Capt. Mark Michaud, the Submarine Force Atlantic surgeon. "What we want to discourage is smokers turning to alternative methods of tobacco use such as chewing tobacco."

Memphis's SOUTHCOM Deployment


U.S. Navy photo

In late June 2010, USS *Memphis* (SSN-691) returned from a successful deployment to the U.S. Southern Command (SOUTHCOM), where she participated in the Atlantic phase of UNITAS 2010 and in Exercise Naiad. UNITAS, the longest-running series of multi-national naval exercises, brings together Western Hemisphere maritime forces to enhance security; improve interoperability; expand maritime domain awareness; and counter maritime activities that could threaten regional stability.

Memphis participated in anti-submarine warfare, anti-surface warfare, and maritime domain operations with the Argentine Navy. She also hosted an Argentine exchange officer, Lt. j.g. Francisco Oleiro. This gave Oleiro the opportunity to observe a U.S. nuclear submarine in action while giving *Memphis*'s crew the benefit of a diesel submariner's perspective.

Memphis then proceeded to Brazil for Exercise Naiad, a tactical development exercise in which she went head-to-head with Brazilian Navy Submarine *Tamoio* (S-31) in a series of challenging events. For this exercise, *Memphis* hosted as an exchange officer Lt. Cmdr. Christian Hingst, pictured above with *Memphis* Commanding Officer Cmdr. Charles Maher. Hingst is the assistant operations officer of Brazil's submarine force.

Five Submarines in RIMPAC 2010

The 22nd biennial Rim of the Pacific (RIMPAC) exercise took place from June 23 to the end of July in waters around the Hawaiian Islands. The 2010 edition of the world's largest multinational maritime exercise involved more than 32 ships from seven nations. Five submarines participated: three from the United States, one from Japan *(below, top)*, and one from Korea *(below, bottom)*. This year's exercise, whose theme was "Combined Agility, Synergy and Support," included 960 different training events.


Photo by Petty Officer 2nd Class N. Brett Morton


Photo by Petty Officer 2nd Class Benjamin Stevens

Photo by Chief Petty Officer Marlowe P. Dix

Admiral Donnelly Turns Over the Helm

by Olivia Logan

Commander, Submarine Forces / Submarine Force Atlantic / Allied Submarine Command Vice Adm. John J. Donnelly has exchanged those distinguished titles for the simpler one of "vice admiral (retired)." Adm. Donnelly turned over the helm to Vice Adm. John M. Richardson in a Nov. 5 change of command and retirement ceremony onboard USS *Montpelier* (SSN-765) at Naval Station Norfolk.

A second-generation submarine officer from Groton, Conn., Adm. Donnelly retired from active duty after 35 years of naval service as a commissioned officer. "I never expected to stay in the Navy this long or progress this far in my naval career," he said. "It's been a tremendous honor to wear this uniform and serve alongside some of the finest people this nation produces."

Adm. Donnelly graduated from the U.S. Naval Academy in 1975 with a major in physics. He later received a Master of Science degree from the Naval Postgraduate School and attended the Massachusetts Institute of Technology Seminar XXI on Foreign Politics, International Relations, and National Interest. He served in five submarines, two of them as commanding officer. His shore assignments have included physics instructor at the U.S. Naval Academy; assistant for undersea warfare and strategic issues on the staff of the Chief of Naval Operations Executive Panel; and assistant for plans and liaison for the Deputy Chief of Naval Operations for Submarine Warfare Requirements.

He was selected for flag rank while serving as chief of staff for Commander, U.S. Seventh Fleet, in Yokosuka, Japan. He went on to become director of combat plans and deputy director for operations and logistics at U.S. Strategic Command; commander of Submarine Group SEVEN, and, finally, deputy commander and chief of staff for the U.S. Pacific Fleet. He assumed command of the Submarine Force in February 2007.

"When I took command as COMSUBFOR, I established three focus areas to align our efforts and improve our Submarine Force," said Adm. Donnelly. "They were titled operational excellence, the professional development of our people, and the modernization and recapitalization of our force. We've made significant progress in each area. I'll probably best be known as the guy who introduced women to the Submarine Force and banned smoking, but my folks have accomplished much more than that in the past four years."

Among Admiral Donnelly's legacies as COMSUBFOR are:

- Improved command relationships for ballistic missile submarines (SSBNs), with Submarine Group Trident replaced by two separate submarine groups, and all SSBNs realigned into two submarine squadrons
- The introduction of cruise-missile submarines (SSGNs), with their innovative new deployment concept
- Continued modernization of the fast attack fleet with new boats of the *Virginia* (SSN-774) class

"Vice Adm. Donnelly, you took leadership skills to new heights as COMSUBFOR," said Vice Chief of Naval Operations Adm. Jonathan Greenert, the featured speaker at Donnelly's ceremony. "Your legacy is that you have made every command better, and led the Submarine Force into the future. You have been a leader who knew how to take care of Sailors, so take great pride in your accomplishments ... Your legacy will endure long after retirement."

"It's been an incredible 35-year adventure," said Adm. Donnelly. "I've completely circumnavigated the globe. I've visited 38 countries. I've been fortunate to serve in command four times—that's exactly three more than my initial stretch goal. I'll never forget the feeling I had as CO standing atop the sail of my submarine heading for deep water so we could dive and disappear. Only a submariner can fully appreciate the close camaraderie of a submarine crew ... I'll always remember the joy of watching subordinates achieve successes they never thought possible."

Adm. Donnelly had no immediate plans for his post-Navy career. He and his wife Mimi were headed for New England to "unwind a little bit, travel and visit family" before considering what to do next. "I do know I want to contribute in a positive way using some of the experience and leadership talents I gained in my Navy experience and put it to good use in the civilian sector."


Photo courtesy of the Paterson Museum

Photo courtesy of the Paterson Museum

Holland I and the "Fenian Ram"

Paterson, New Jersey

At the far end of the Paterson Museum in Paterson, N.J.—beyond displays of early Colt revolvers, a silk loom, and rotary aircraft engines like the one that powered Lindbergh's Spirit of St. Louis—sit two iron hulks. One is 14 feet long, with tapering slab sides and diving planes amidships. The other is a 31-foot vessel with rear planes that roughly resembles a blimp. Placards identify them as *Holland I* and the "Fenian Ram" (also known as *Holland II*). Both are major milestones in the invention of the modern submarine, so why are they at a local museum in an old locomotive factory?

It's a long story. In 1781, the state of New Jersey chartered the Society for Establishing Useful Manufactures (SUM), whose leaders included Alexander Hamilton, one of America's founding fathers. SUM's goal was to found a city of factories that would help transform the still-rural United States into a great industrial nation. Factories needed power. Just a few blocks from the Paterson Museum, the Passaic River plunges over a 77-foot waterfall into a scenic gorge. SUM set out to build a massive waterpower system to harness the falls.

The mills that sprang up around this "raceway system" (now part of a National Historical Park established in 2009) attracted immigrant workers, including many Irish Catholics. Some belonged to the Fenian Brotherhood, which sought to overthrow British rule in Ireland. In 1874, Irish immigrant John Holland arrived to teach in one of Paterson's Catholic schools. Holland had long dreamed of inventing a practical submarine, and he was also an Irish patriot, so in 1877, he proposed that the Fenians fund a small submarine to attack British ships in Irish waters.

After the tiny *Holland I* proved the basic concept with test dives in the Passaic, the Fenians funded the building of a larger, operational boat in New York City. Before leaving Paterson, Holland cautiously scuttled his prototype. Newspapers dubbed his second boat the "Fenian Ram." Tanks of compressed air allowed its primitive internal combustion engine to run while submerged and also powered a pneumatic gun for throwing dynamite charges. Holland tested the boat successfully in New York harbor before a financial dispute with the Fenians abruptly ended the project in 1883.

Holland never returned to Paterson. After many setbacks, he finally built the first modern submarine, *Holland VI*, in 1897 and sold it to the U.S. Navy in 1900. In 1927, Paterson-area youths interested in engineering raised *Holland I* from the river. That same year, Paterson resident Edward Browne purchased the so-called Fenian Ram and presented it to the city. So these vessels are not in Paterson just by chance, but because visionary leaders like Hamilton founded a great industrial city, enterprising dreamers like John Holland thrived there, and Paterson values their achievements.